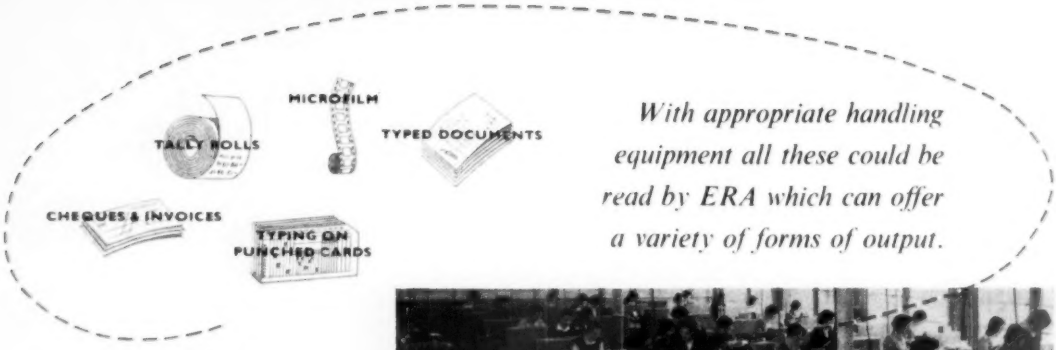
Vol. 1 No. 1

Price 3/6

Automatic Data Processing

Issued by BUSINESS Journal of Management



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(Electronic Reading Automaton)

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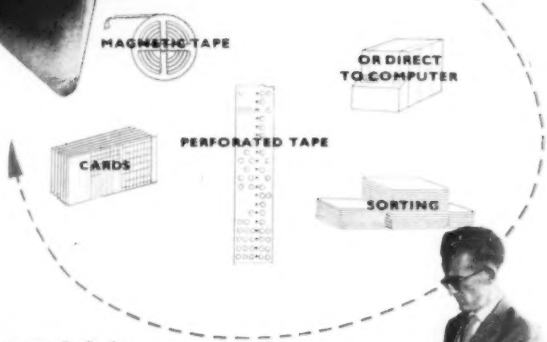
ERA automatically takes *existing* business documents, *reads* them at up to 300 characters per second, and gives a direct translation from the human language of the printed character into the "machine language" of punched cards, punched tape and computers. It can often reduce the cost of feeding a computer by up to 90% and thus makes a computer an economic proposition to many firms who previously considered the cost of feeding one excessive. Boots the Chemists, who bought the first production model, had a typical application — to read, at head office, the tally rolls from cash registers in their 1300 chemists shops.



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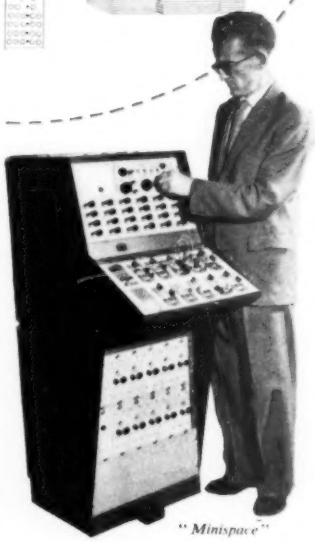

"Minispace"

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Automatic Data Processing

Issued by **BUSINESS** Journal of Management

Vol. 1. No. 1. Mid-November, 1958

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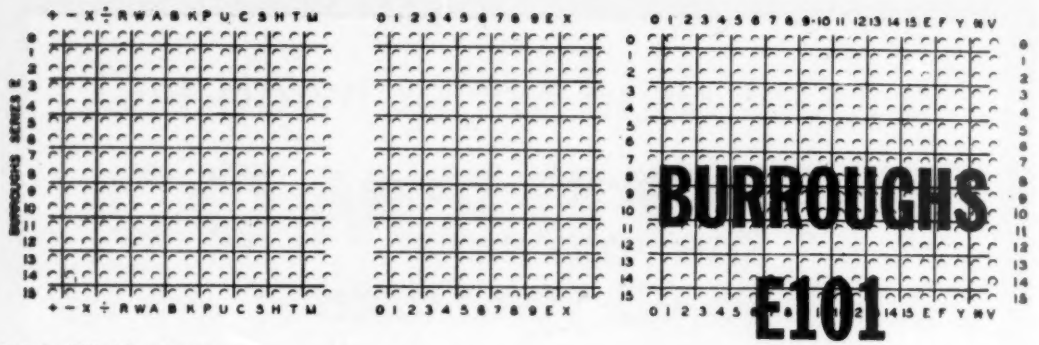

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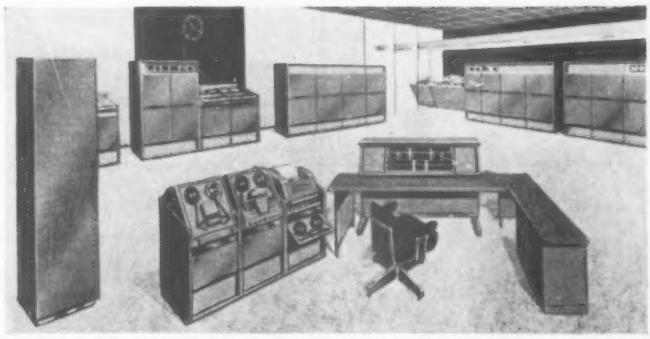

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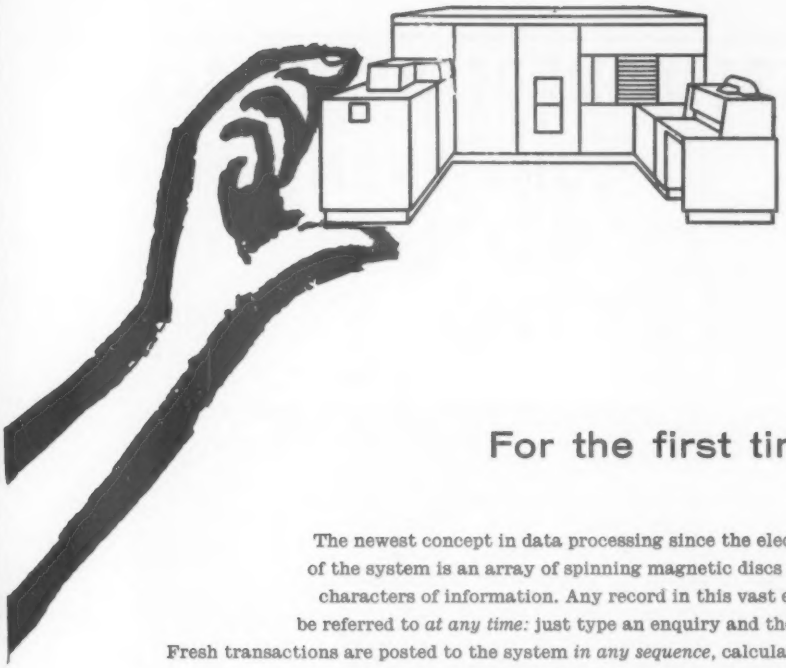

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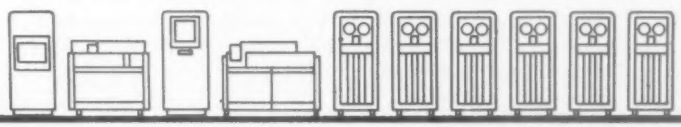

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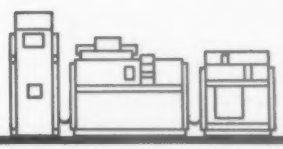

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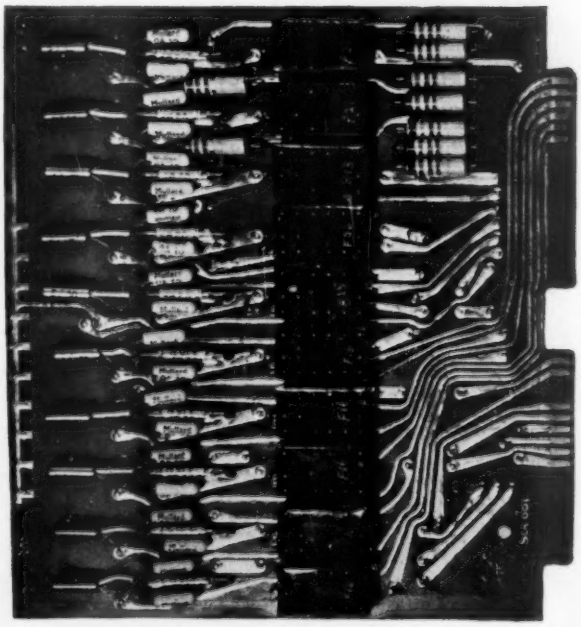

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The Metrovick 950

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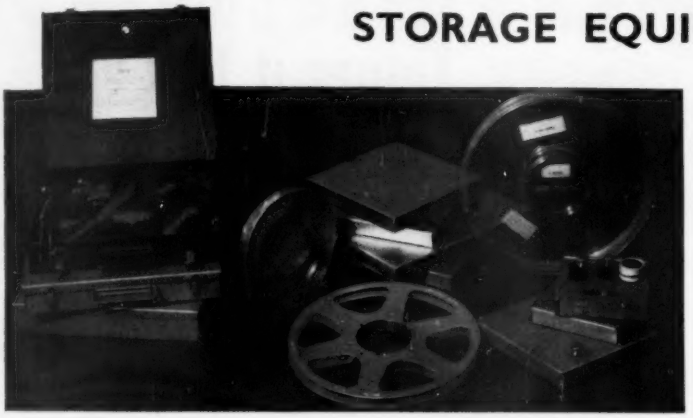

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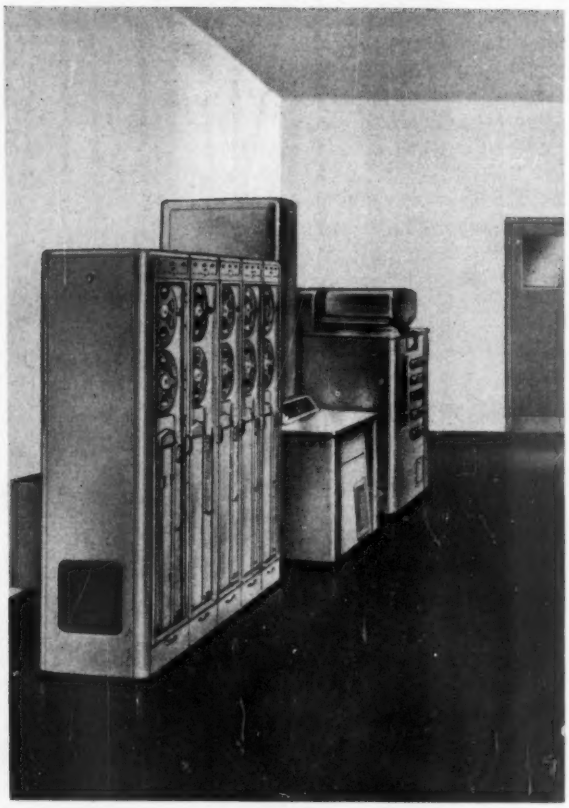

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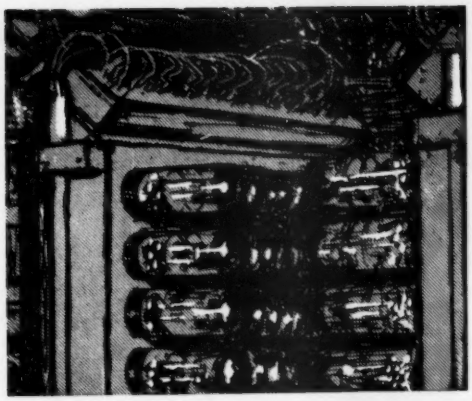

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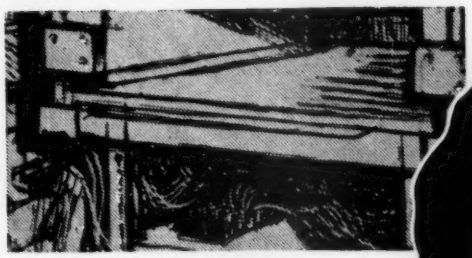

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AUTOMATIC DATA PROCESSING —

AUTOMATIC DATA PROCESSING, the second issue of which will be published next March, and thereafter regularly every month, is a top management journal devoted exclusively to the electronic revolution in:

- Market Forecasting
- Order Handling
- Accounting
- Production Planning and Control
- Delivery Scheduling
- Stock Control
- Automatic Machine Control
- Process Control
- Data Recording and Reduction
- Computing for Research and Development

and other aspects of Automatic Data Processing

How AUTOMATIC DATA PROCESSING will Cover its Subject

AUTOMATIC DATA PROCESSING will not be a dry-as-dust technical journal. True, it will—it must—be intensely practical and specific, but it will deal with its subject in such a clear and lucid manner that every page of every issue will be illuminating and a pleasure to read. Illustrations. charts and diagrams will clarify the text. However complicated machinery or processes may be, experts will explain them in clear, everyday language, tell you what they will do for you and how to get the maximum advantage from them.

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a saving of 15/- on the regular price of 45/-.

On the occasion of the Electronic Computer Exhibition at Olympia (28th November to 4th December), Olivetti proudly present their contribution to fully integrated mechanical accounting.

The Olivetti Audit accounting machine incorporates a numerical and alphanumerical mechanical perforator. The perforator controls are completely automatic. The programme bar gives four independent programmes.

The elimination of sprocket holes in the tape permits asynchronous movement of tape when perforating and reading. The six channels on the tape provide for coding of numerical, alphanumerical and service data.

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Can be linked to electronic computers.

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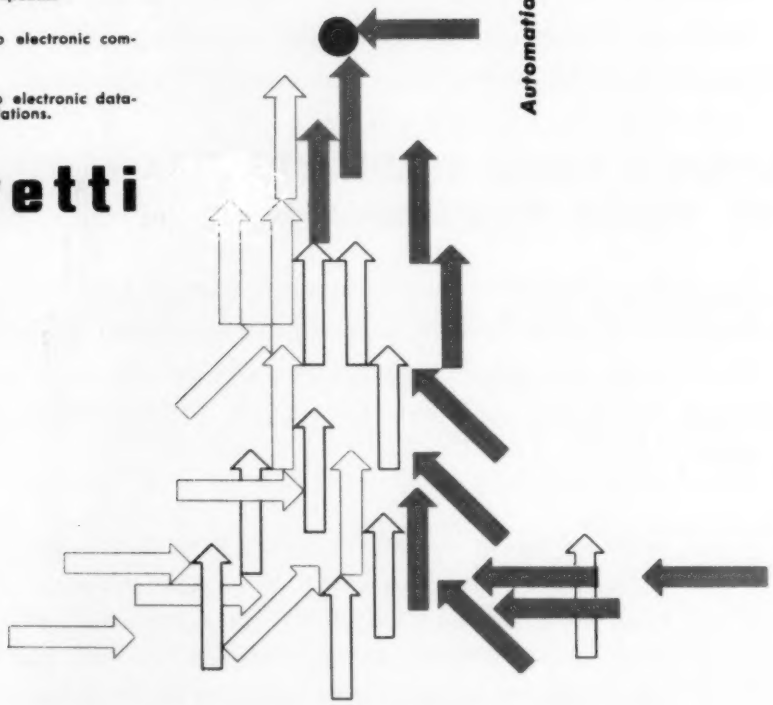
Automation speeds the flow of data to the centre



British Olivetti Ltd., 30 Berkeley Square London, W.1

80

- *Widening scope for automatic control*
- *Where the smaller firm fits in*
- *How ADP will affect executive jobs*

Revolution in Management

AUTOMATIC data processing is a revolution. It has been in progress for some time but the electronic computer has brought it to a head.

This impressive piece of equipment was originally produced for military and scientific purposes. Then it was offered to businessmen. They had neither asked for it nor sponsored its development. The machine simply arrived—without a book of instructions. Yet more and more businessmen are now recognizing the value of learning how to use it properly.

In that sense the computer is the inspiration of the ADP revolution in office and works management. Certainly it is the pace-maker.

However, it is dangerous to place too much emphasis on electronic 'hardware.' ADP is not a machine or even a battery of machines. Essentially it is concerned with systems—with better ways of planning and doing business work.

For this reason ADP actually employs a wide range of electronic and non-electronic devices. Some of these are brand new; others are 'conventional.' Some are linked with a computer installation; others—like the tape-operated typewriter and the selective addressing machine—may provide some degree of ADP on their own.

There is at present a tendency to think that 'data processing' means clerical work; moreover, that it is simply a method of hotting-up established departmental routines. But business data is seldom restricted to one department. It flows through the whole organization. Even the more specialized flows are closely inter-related with the total information which 'drives' the business.

An example is the automatic production of components on a numerically controlled machine tool. Drawing office information is translated into machine instructions—sometimes, but not necessarily, by a computer. This is not a private transaction between a draughtsman and a workshop superintendent. In fact the instructions originate from the customer who wants the components. The ADP operation at the point of manufacture is one stage in a continuous flow of information which starts with the receipt of an order.

Ideally, the whole flow would be automatic; and in certain types of business this will eventually happen. For the time being, ADP will generally be applied on a sectional basis.

But the pattern of future development is most clearly defined in the process industries. Traditional methods of instrumentation consist of reading-out 'secondary' data which is largely concerned with the behaviour of the plant. Information on the products themselves is obtained more laboriously by analysing samples extracted at various stages of processing and eventually pass-

ing the results to control points.

In future much greater use will be made of the new techniques of data reduction. Information on the products of the plant will be read out in the forms which are immediately useful.

The next stage will be to feed back 'primary' information of this sort so that the behaviour of the plant is automatically adjusted to give the best end-products in the most economical way. It is here that digital computers (of the same basic design as office data processing machines) may play their most important role.

But production must be linked to the commercial side of the business. So eventually the process control system will draw some of this input data from the sales department and supply some of its output data to costing, accounting, order-handling and other units.

Looking even further ahead, there is no reason why the same principles should not be applied to firms engaged on mass, batch or unit production. These are the logical conclusions of ideas which some firms are developing now.

Breaking down departmental barriers

Few firms have jobs which are big enough, on their own, to justify the cost of installing a computer. So prospective users are being forced to think in terms of company-wide installations.

This breaking-down of departmental barriers may have a profound effect on business organization and systems work—even where non-electronic equipment is used.

An example of the new approach is provided by Boots Pure Drug Co. They believe that "the most important thing that ever happens in our organization is when somebody walks into one of our branches and says, 'I want that article'." So their £1¼ million venture into ADP is starting with a central system which automatically 'reads' and analyses sales information printed at their branches on cash register rolls.

In parallel with this, Boots are installing a large computing system to process orders from the branches. The two set-ups will have no ADP link at first; but during the next few years Boots hope to develop them into a fully-integrated system. Then information on that 'most important thing'—what the customer wants—will pass automatically to their warehouses and factories.

The same principle is being developed in other ways. One method (described in the January, 1958 issue of BUSINESS, page 87) uses small pre-punched cards as sales tickets. Whenever an article is sold, the ticket is detached and sent to H.Q., where it is processed on mechanical equipment. At present the users—retail chain stores—are restricting this system to sales analysis. But eventually it will be used to place 'automatic' orders on suppliers, thus maintaining stocks on levels prescribed by the management.

ADP in the smaller firm

It is significant that in each of these examples very small operational units are taking part in an ADP system. Admittedly, they are branches of large companies. But before long, some small companies may be co-operating with their large suppliers or customers in the same way. There is a foresight of such developments in (for example) the use of standard translucent order forms which can be processed by a semi-automatic photocopying system.

ADP will also affect the smaller firm more directly. First, big firm activity will promote the development of simpler types of automatic or semi-automatic equipment. Second, the versatility of electronic systems—together with new thinking on methods of integrating different jobs—will commend the desk-size computer of the not-too-

The development of ADP is creating new management posts. As this advertisement from "The Times" shows, the more progressive firms are already seeking out their key men of tomorrow.

DATA PROCESSING MANAGER

Applications are invited for the new position of Data Processing Manager. Initially, the selected applicant will be responsible for the preliminary programming and installation of an I.B.M. set-up using their latest electronic calculator. Subsequently—whilst retaining overall responsibility for the I.B.M. unit—he will investigate and promote O & M activities generally.

Applicants must have had experience not only of Punch Card techniques, but also of programming the installation of Data Processing equipment—not necessarily I.B.M. A training course in the use of I.B.M. equipment will be given by the manufacturers.

Further, he must have had direct training and experience of O & M work generally.

Preferably, applicants should be under 35 years of age. A salary in the range of £1,500-£2,000 is contemplated (dependent upon qualifications), which makes this an attractive senior position—being directly responsible to Commercial Director; it also offers excellent opportunities for advancement.

Usual Pension Scheme arrangements. &c.

Applications [illegible]

distant future to firms which would hesitate to spend a few thousand pounds on a single-purpose machine.

Broadly, there are four ways in which ADP will help management. They are very closely related.

The first is by linking 'departmental' data processing operations into a continuous and automatic flow-line. Thus vital information will pass from one end of the business to the other more quickly and more accurately than if there were human links at various points.

The second way is by applying the principle of 'feed back' or 'closed-loop' control to a variety of business activities.

A simple example of feedback is the thermostat in a domestic boiler. Here the temperature of the water controls the heater and the heater controls the temperature of the water—thus providing the closed loop. In a business application, feedback of sales information might control the output of a factory in order to maintain stocks at prescribed levels.

This is, of course, a much over-simplified example. To take into account other criteria—such as efficient loading of plant—there would have to be a whole series of inter-related closed loops. The computer opens up new opportunities in this field because of its ability to store large numbers of instructions and co-ordinate large quantities of data from different points.

The third group of ADP applications concerns business decision-making. Feedback control comes into the picture here because it will absolve managers from much of the responsibility of basing day-to-day decisions on 'hunches' or out-of-date information.

There are even greater prospects in the neglected field of forward planning—which is, in fact, the setting of new criteria for day-to-day operations. Through the use of simulation and other scientific techniques, a computer can predict the results of following different policies. Reverting to the thermostat example, the efficiency of the system can be determined within reasonably accurate limits before the current is switched on.

Effect on executive jobs

None of these ideas will be exploited fully without making significant—and often radical—changes in management structures. As pointed out by one of the writers in this issue (p. 35) executives will have more time to concentrate on the purely professional side of their work. At the same time there is bound to be a shift in the balance of power between 'staff advisers' and 'line executives.' The systems involved by the so-called advisers will lay down more positively the limits within which the executives work.

The setting of standards of performance will become more onerous than at present, because more will depend on them.

Problems will also arise when deciding what information is needed to provide automatic control.

The development of ADP systems is a top management responsibility. It is they, and not the administrative or technical specialists, who can provide the insight and authority to break down barriers between different departmental functions—and also between the manufacturing and commercial sides of the firm. *END*

How ADP can increase profits

Reductions in clerical labour—so often emphasized—are probably the smallest of the potential benefits of ADP. Much bigger savings will be made by speeding up the flows of information in a business and by putting management decision-making on a sounder basis.

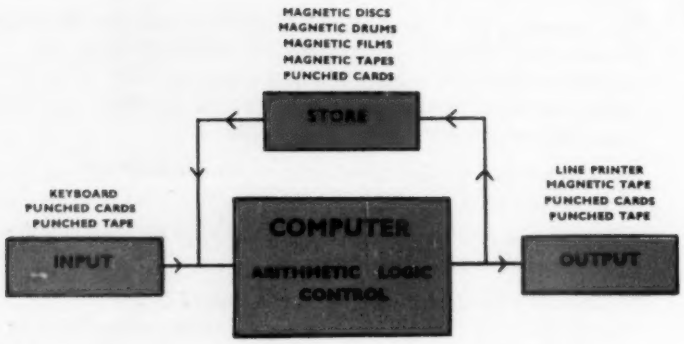
For example, the 'integration' of market and sales data with production and material control will avoid (1) tying up capital in excessive stocks and work-in-progress; or (2) losing business because of inability to supply from stock or to quote reasonably short delivery dates.

Here are some of the other ways in which ADP will help to reduce costs:

- **Better use of plant and material through more scientific and flexible work scheduling.**
- **Cheaper distribution through the use of linear programming and other techniques to improve delivery services, salesmen's calls, warehouse organization, etc.**
- **More exact long-range planning through market and sales analysis and the simulation, or pre-testing, of possible courses of action.**
- **More competitive tendering on the basis of scientifically calculated risks.**

Any of these, on its own, may justify the expense of ADP even where staff savings are negligible.

How a



AN electronic digital computer is 'superhuman' in two respects only. It does arithmetical calculations at fantastically high speeds; and it makes logical decisions quickly, accurately and consistently.

In mathematical or scientific work a lot of arithmetic has to be done on a little information. In clerical routines, a little arithmetic has to be done on a lot of information. So for business purposes the automatic input, output and storage units are just as important as the computer itself.

ARITHMETIC. This is done by electronic counters and other non-mechanical devices. Although most computers work in binary code, the conversion of data is automatic.

With ordinary desk machines, an operator has to initiate and control each stage of a calculation. Electronic computing differs fundamentally from this because the machine performs whole *sequences* of calculating steps without human intervention.

Of course some non-electronic calculators can be 'sequenced' or 'programmed.' But the computer goes further:—

—In its electronic 'memory' it can store a much larger number of steps than could be set up mechanically.

—A complete programme can be inserted (and later erased from the machine's memory) in a very short time.

Moreover, if certain foreseeable conditions arise during the calculating sequences, the machine has the ability to modify the instructions which have been fed into it—again, on pre-determined lines. Thus an automatic computing routine may involve many more steps than are stored in the machine to start with.

LOGIC. A lot of nonsense is talked about 'brains' and 'thinking machines'. What a computer *can* do is to make 100 per cent reliable decisions on the strength of 'experience' or other criteria which a human being has written into the programme instructions.

These decisions are based on 'go—no go' logic. Suppose the machine is processing customers' orders and simultaneously updating the corresponding stock inventory records. As each item is taken, the quantity ordered is automatically subtracted from the quantity left in stock after previous orders in the batch have been accounted for. If the result of this simple sum is positive, the machine does one thing; if negative, it does another.

Such powers of discrimination can be extended almost indefinitely. Thus a computer can make quite complex decisions—as long as conditions governing each 'go—no go' stage can be specified clearly.

CONTROL. To produce the programme, the job (whether a mathematical problem or a clerical routine) has to be broken down into a series of calculating and data-handling steps. These are coded, punched into tape or cards, and automatically read into an electronic memory inside the computer (see below) where they are continuously available.

Then the programme tape or pack of cards is returned to a file for use when the job is done again.

INTERNAL MEMORY. This is usually a fast-rotating magnetic

Computer Works

A PLAIN LANGUAGE GUIDE

drum. Information is written on it (and erased from it) in the same way that sound is recorded on magnetic tape.

The drum has a fairly limited capacity. As well as storing the programme, it temporarily holds the results of intermediate stages of the calculations (like the 'carrying-over' of figures in mental arithmetic) together with sub-totals and other data for the production of summaries at the end of the run.

DATA HANDLING. Often there is confusion over the respective functions of input, output and storage. In fact these are complementary.

Imagine a manual order processing system. The clerk—

—gets new information (the customer's order form);

—merges this with standing information from a file (particulars of the customer, stock position, etc.);

—does a little arithmetic on it (in his head or on a desk machine);

—writes the prescribed documents (e.g. invoice, despatch note);

—updates some of the information in the file.

A computing system works in the same way—but automatically. It has direct input and output devices, and also a large-volume memory system which, like the file, both provides and accepts information as the calculations are made.

Today computing systems are built on the 'interchangeable block' principle. Various input, output and storage units can be coupled to one calculating and control unit (see sketch).

INPUT. Because new information is received in fairly small amounts, it is appropriate to use such relatively slow media as punched tape and punched cards. These are read automatically by mechanical or electronic means. Occasionally keyboard entries are made.

The input tapes or cards are punched from original documents in a separate operation. Sometimes automatic punching units are attached to typewriters, calculators, and other data-originating machines.

OUTPUT. The results of a computing operation may be recorded in code on punched tape, punched cards or magnetic tape. From these working documents (payslips, invoices, etc.) or other tabulations are produced 'off-line' by an automatic printer.

An alternative is to use an automatic printer 'on-line'—that is, coupled direct to the computer.

AUXILIARY STORAGE. This is quite distinct from the 'internal' memory system, which really belongs to the calculating and control equipment.

In simple installations, punched cards may be used for 'storage'. But for large-volume commercial routines the emphasis is now on magnetic storage systems using:—

—Magnetic film.

—Magnetic tape (on spools or in loops).

—Very large magnetic drums.

—Magnetic discs held in a sort of 'juke box'.

Where tape or film is used, the new input data is sorted, before the job starts, into the same sequence as the corresponding information in the store. The magnetic disc system permits information to be processed in random order; so does the use of very large drums. *END*

Can You Afford

Electronic data processing is not just for the big boys. It may well show a good return in any business employing more than 40 clerks on jobs that can be 'integrated'

By A. J. BROCKBANK
Glaxo Laboratories Ltd.

MANAGEMENT would find it easier to assess the merits of ADP proposals if computers were simply a development of equipment already in common use. But where proposals relate to investment in equipment that represents virtually a clean break with past experience, one can understand why some managements hesitate to take the plunge.

This attitude is all the more understandable where the proposals under consideration involve the expenditure of a very large sum of money, and also a considerable degree of reorganization within the company if the new equipment is to be utilized most efficiently.

There is, however, evidence that many companies have decided to defer action because they have not appreciated that investment in electronic data processing equipment can be undertaken with far less risk than investment in more familiar equipment, such as punched card or keyboard accounting machinery.

Of course the economic feasibility of electronic data processing depends on many things. This article deals with some of the basic considerations which help a firm to determine whether or not the position should be investigated more fully.

Not 'big enough'?

The management, having read of computers being ordered by such companies as I.C.I., Ford and Shell, may assume that their own business is too small to warrant an investigation, let alone the placing of an order. Yet a study of the potential use of computers has shown that this assumption is often misleading.

It is now evident that, in certain circumstances, a small company may have a sounder case than a larger company for investing in a computer system.

The three types of business which may benefit are those with:

— A large volume of clerical information which needs fairly simple processing.

— A small volume of clerical information which needs complex processing.

— A mixture of the above.

On this basis, the number of companies which would secure an economic return on investment in a computer system is considerably greater than was initially thought to be the case. Further, when the ability of the computer to take over certain functions in the area of decision-making is considered, the scope for securing economies in administrative and operative costs is widened still more.

a Computer ?

Assuming that (1) a computer system is used for the widest possible range of work and (2) the write-off period is taken as 10 years, a company employing as few as 40 people on the clerical functions of accounts, costs, stores control, invoicing, statistics, production planning, progress control, etc., may well find that investment in an electronic data processing system is a sound economic move.

Better to wait ?

When a *prima facie* case has been established, the next points which usually arise are: whether action should be deferred until more experience is available regarding the use of computers in industry—if not, what type of installation should be ordered?

The feeling that it might be better to defer action stems from the instinctive dislike of most people to venture into the unknown. This, with the rapid development of ADP, all too frequently offers sufficient excuse for doing nothing. By waiting, it is argued, one may well learn from experience of others and so avoid making costly mistakes.

To get this aspect of the problem into correct perspective, it is necessary to understand the significant difference between computers and other equipment.

First, remember that a computer is not in itself an electronic data processing system. It is the 'brain' of the system, controlling the activities of its 'eyes' and 'hands,' the 'eyes' being the various types of reading mechanism that feed the data in, and the 'hands' the reading heads or printers that feed the data out. Associated with these features are the electronic 'files' in which either fully or partly processed data is stored until required.

The instructions to perform allotted tasks, and also the data to be performed upon, are translated by the computer into coded electrical impulses. These, in effect, take the place of the gears, shafts, levers, wires, etc., which represent alphabetical and numerical symbols in mechanical or electro-mechanical equipment.

This fundamental difference between electronic and mechanical systems means that whereas mechanical equipment is usually 'tailored' for specific classes of work, the computer equipment supplied to different companies for different purposes will be substantially identical apart from drum storage and peripheral units.

Thus, for the first time, there is available true general-purpose equipment that can be employed on any work in the sphere of clerical processing—the limit of its usefulness depending on the skill of the people using it, and not on limitations imposed by the equipment itself.

No longer will significant changes in requirements call for investment in new machines. As is well known, the cost of modifying mechanically-operated equipment is usually greater than the purchase of new equipment. But with electronic systems the user has only to write fresh programmes —the cost of which becomes less as experience increases.

Current development work is

'Integration' at Glaxo

For some time the author of this article has been in charge of a computer project at Glaxo Laboratories Ltd. Their machine—an EMIDEC—is to be installed next year.

Because of expansion the company were faced with the alternatives of re-equipping with orthodox punched card equipment or plunging into electronic data processing. The latter, after careful consideration, seemed to offer the best investment.

A study revealed that no single job was large enough, on its own, to justify the cost of buying a computer and bringing it into operation. The answer has been found in a policy of 'integrating' jobs for a number of departments, starting with home sales order processing and related work.

No longer will significant changes in the requirements of a business call for investment in new machines. With electronic systems the user has only to write fresh programmes . . .

mostly concerned with peripheral equipment. This, it should be noted, is not inbuilt but 'hooked up' to the computer. Therefore just as one has been able to have converters added to one's television set, enabling reception of ITV programmes, with a computer installation one will be able to replace or extend existing peripheral equipment.

It follows that, subject to buying a computer with multiple input and output facilities, a company can invest in an electronic data processing system with the assurance that their installation will be capable of handling any work in the clerical processing field, either now or in 10 or more years' time. What is more, by the use of new and faster peripheral equipment and the rewriting of programmes, they will be able to cope with any increase in the volume and/or complexity of their clerical work resulting from either growth or significant changes in the characteristics of the business.

Will prices fall?

Another common reason for deferring investment is the belief that the cost of installations will come down as production increases. While this may be so on a long-term basis, so far as the immediate future is concerned computer installations are likely to cost more and not less.

The majority of the components used in a computer are already in volume production. Also, one of the larger cost elements of an installation is that of bringing it into operation following assembly.

This brings us to what is perhaps the most widely discussed and misunderstood aspect of the subject. The cost of transferring clerical work to a computer system can be high or relatively low—depending on the approach. *But if the right approach is made it need not be higher than the cost of transferring work to an orthodox punched card system.*

The requirements to ensure low cost in this sphere may be summed up as follows:

1—A clear appreciation of how a computer system operates.

2—Recognition of the fact in studying a computer application, one is not concerned with improving the existing methods but with transferring work from human handling to automatic machine handling.

3—Responsibility for the methods applied within this machine system must rest with the programming staff. Knowledge of how the human machine functions is likely, therefore, to be of little, if any, value in planning work for the machine system.

In designing a computer system, a clear understanding of the purpose of the work to be done, together with factual information regarding the source and volume of input data and the volume of output required, are more important than the most beautifully executed flow charts detailing existing methods.

The understanding of the purpose of the work is substantially a matter of logical thinking and investigation. The collection of factual information is primarily an exercise in data recording.

Experience in other spheres of office mechanization may not be of any real value. This contention is supported by the experience of American companies which considered it wise to approach the use of computers by two stages, stage one being the introduction of punched card equipment or other mechanized systems. Subsequently they found themselves faced with most of the problems that, with the one-step approach, are tackled at the outset.

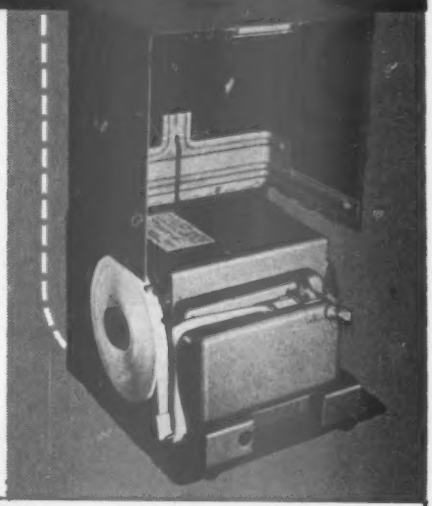
What about breakdowns?

Many businessmen are concerned about the reliability of electronic data processing systems. This is understandable because the high cost of the equipment precludes other than the largest companies from duplicating it. Thus the user is compelled to place all his eggs in one basket, against his natural instincts and experience.

Happily the available experience in the use of electronic data processing systems is reassuring rather than otherwise.

Experience with computer components in other fields, suggests, that—subject to sound design and engineering—a computer will be inherently more reliable than the more complex types of mechanical or electro-mechanical office machinery. This claim is supported by the experience of some users of punched card equipment, who have found that the electronic parts of electronic calculators give less trouble than the mechanical or electro-mechanical parts of an installation. *END*

The *National* Class 31 direct-entry Accounting Machine in combined operation with The *National* 461 2 Punched Paper-Tape Recorder



For automatically encoding basic data as a by-product of the normal posting of conventional, 'hard copy' records as required for local action and control purposes at all points where data originates.

NOTE : *Data held on tape may be translated to* PUNCHED CARDS, *entirely automatically, at very high speeds.*

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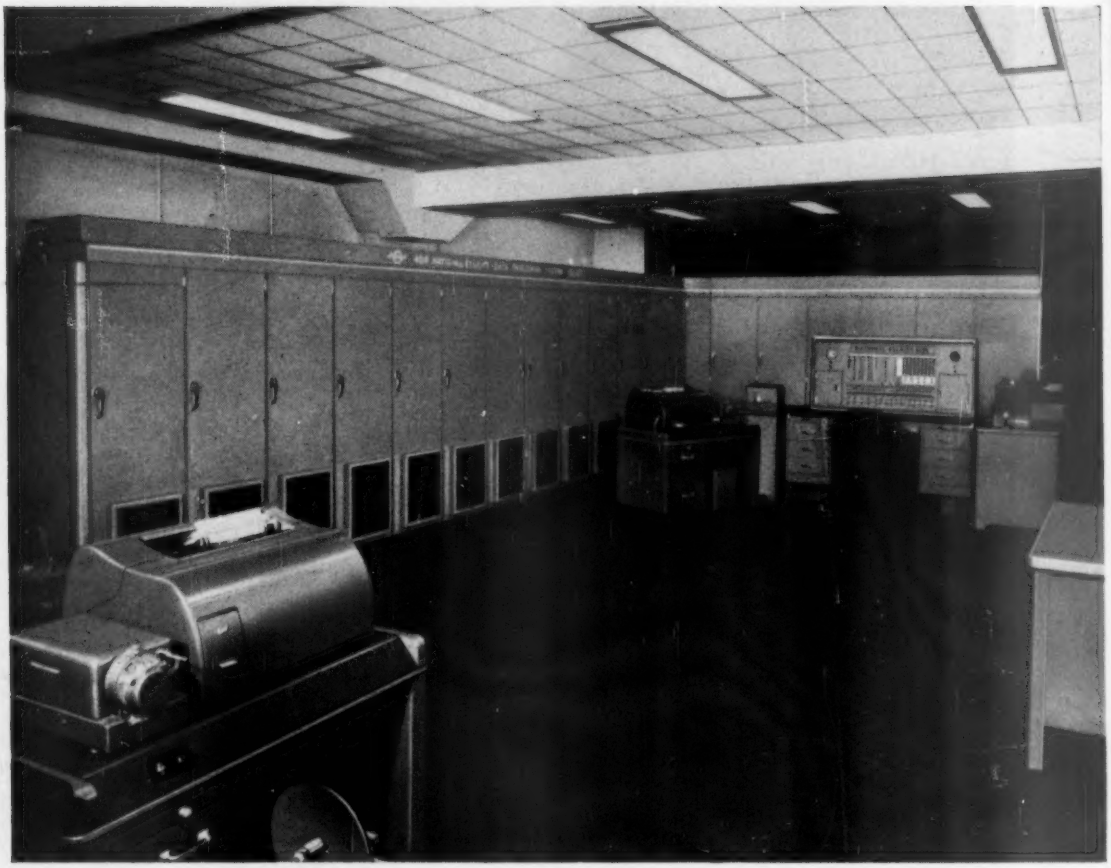

Electronic computers of various types are already in use in considerable numbers in Gt. Britain, but of those developed specially for commercial and industrial accounting applications, the National-Elliott 405 leads the field as the one most widely adopted for carrying out full-scale *integrated* data processing programmes.
Illustrated above: A twenty cabinet all-purpose installation incorporating four magnetic film units (for "writing" and up-dating the "main data file") and a high-capacity fast-access disc memory for the storage of (a) programmes and (b) data selected, automatically, for actual processing.

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Line Printer operating from 405 film output

ALSO: *Tape Readers; Card Readers; Tape-to-Card Translaters; Character Printers; etc.*

A CASE STUDY THAT LOOKS AHEAD

A Pattern for Management, 1968?

Integrated data processing is not just a method of hotting-up old routines. It needs new thinking. Line managers may lose some of their current responsibilities—but gain in other ways.

IN the early days of electronic data processing, much was heard about its repercussions on clerical workers. Experts spoke of large-scale labour economies or, as a palliative, of 'freeing' clerks for more dignified (but rarely specified) tasks.

Now there is a growing realization that the main repercussions will be on executives.

This is because the development of decision-making techniques will usurp some functions of line management; and also because data processing methods cannot be fully integrated without upsetting traditional principles of organization.

Current thinking on this score is neither unanimous nor clear. Most of the first computer users have chosen a fragmentary approach—'computerizing' old routines rather than creating completely new systems.

Their choice is understandable. But it probably accounts for many of the failures and semi-failures which have already occurred in the U.S. and may be duplicated here.

Nevertheless some companies are developing new ideas. Among them is the International Latex Corporation, with headquarters at Delaware, U.S.A. This article is based on proposals made by Lionel E. Griffiths, formerly manager of I.L.C.'s machine accounting department and now Assistant Controller, Services.

I.L.C. make a diversity of products, including pharmaceuticals, ethical drugs, industrial chemicals, brassieres, girdles and gloves. In their central organization they have a fairly large punched card accounting installation, together with an electronic data processing unit based on an *IBM 650* computer. Eventually a *Ramac* (random-access) system is to be installed.

Mr. Griffiths's proposals are concerned with the ways in which the structure of the organization will be affected by the rationalization of information flows. He does not deal with the use of 'simulation' and

other ADP techniques for long-range forecasting and planning.

Not everyone will agree with his proposals. Some may choose to detect in them a threat of empire-building by systems men. But new assessments are badly needed. ADP cannot advance properly until some of the sacred cows of management are herded out of the way.

Why new ideas are wanted

UP to now the development of automatic data processing methods have been hamstrung in two ways:

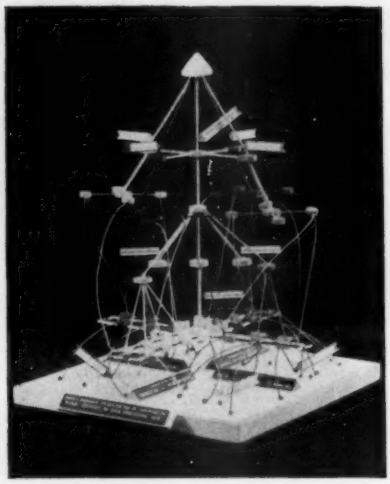
First, the early stages of this revolution were largely 'master-minded' by technicians and specialists. They seem to have regarded the computer in the light of their own areas—to the accountant, for instance, it was just a faster, more powerful adding machine.

Second, business organization today is virtually archaic. Organization structures are based on military lines which have themselves become out-moded. It is common, for example, to find the manager of a 'machine accounting department' reporting to a controller. Yet the term 'machine accounting' is now practically a misnomer. Machine operations are seldom confined to the financial or accounting functions: very largely they provide information for the 'total' business.

Therefore it is essential to develop a new concept of data processing, rather than try to hot-up applications which were evolved, piecemeal, many years ago.

The present organizational structures are mostly by-products of three traditional business areas: manufacturing, marketing and accounting. They ignore the development of new and important areas.

Management's need for fast, accurate and detailed information is more likely to increase than to diminish. It can be met only by thinking of organization as a totality.



INFORMATION IN 3-D. A formidable way to depict business operations? But the traditional organisation chart may be too inflexible to put over new ideas. This model was made by the Machine Accounting Department of I.L.C. to show how information flows can be coupled to a data processing 'hub'.

A major defect of the present structures is that responsibility for 'means' and 'ends' had got mixed up. Each area contains two elements: the 'intellectual' content of the professional work concerned, and the control of mechanical methods of providing information for this.

It is often assumed that professional men are capable of picking up the essentials of systems as they go. As a result, the mechanical features of organization have received somewhat cursory attention. Also this approach has created one of the biggest difficulties of modern business: the use of the chemist as organizer and administrator, the use of the accountant to resolve paperwork problems. Special talent and knowledge are squandered—without getting the best systems.

Moreover, in the present set-up a systems department cannot do its job properly because it has little or no line authority. Thus its efforts are often restricted to a few basic routines or to the accounting area. To be effective, it must penetrate practically all areas where action is facilitated or controlled by large-volume paperwork.

ADP changes the situation

In developing a broad plan for re-organizing their systems during the next few years, I.L.C. have assumed that:

—Electronic data processing is not just an extension of punched card and other machine operations. It creates a new systems situation.

—Within a computer system, using basic files of information, it is possible to develop a complete information flow which produces up-to-the-minute sales statistics, invoicing data, accounts receivable data, inventory and availability data, etc., as and when these are needed.

—Paperwork and communication problems will continually grow and become more complex. Only a 'total' data processing system will bring them under control. At the same time, the 'discipline' introduced by ADP will force management to decide what information they really need.

—Factory and office will be linked more closely by the web of information.

Developing 'flows' of information

The I.L.C. concept is based on the belief that in any business there

is a limited number of natural information 'areas' or 'flows.' Each forms a chain of events from which various by-products can be extracted. *But for maximum efficiency they must be centred on one data processing 'hub.'*

The I.L.C.'s basic information flows are:

1—Sales and customer accounting.
2—Production and inventory control.
3—Payroll and labour accounting.
4—Materials and payables accounting.

A fifth flow—largely a by-product of the others—is the building up of information on customers, vendors, products, sales territories, salesmen, and so on.

Other businesses may identify different flows; a wholesale firm, for instance, would probably need one for transport and distribution. But the basic principle is applicable to all types of enterprise.

The flows are not necessarily self-contained; one may produce output which becomes input to another. For example, pre-billing against availability in Flow 1 (above) is linked to production and inventory control in Flow 2.

Usually a flow originates from one piece of a paper. Consider sales and customer accounting. It starts with the entry into the information area of a completed order form. From this, and also from standing files and secondary documents, it is possible to:

—Calculate freight charges.
—Produce the invoice.
—Update the accounts receivable ledger.
—Age the account.
—Print statements.
—Record the receipt of cash.
—Obtain sales statistics.

In fact, the flow starts with the design of the order form, since this largely determines the information which can be extracted from the sales and customer accounting cycle. And to design forms which meet future as well as present needs, systems engineers must know a great deal about the company's short- and long-term plans.

How an integrated system works

The I.L.C. breakdown of information flows is not revolutionary. But the way in which flows are controlled presupposes radical changes in line authority and upsets some of the accepted principles of organization.

Take the sales and customer accounting flow in its present form. Strung on to it are various working units: order processing, machine accounting, shipping, accounts receivable, customer service, credit, and so on. These report to different divisions, mostly directed by men with specialized backgrounds and training. To reconcile the specialists' ideas and needs is difficult.

Under the 'hub' system envisaged by I.L.C. the input/output units on each flow are controlled by an information flow director. The I.F. directors, together with the director of the data processing centre, report to a top-level administrator.

The main purpose of each flow is to collect and prepare information for the data processing hub; its secondary purpose, to distribute this, after processing, to the specialist areas. For example, details of stores receipts and issues are passed to the hub, where the inventory files are updated and summaries or analyses are made for such departments as production control and purchasing.

Each input/output unit is regarded as part of the total systems and paperwork set-up: it has no line authority or responsibility to the specialized areas of finance, manufacturing, marketing and distribution. (For example, 'accounts payable' and 'accounts received' are input/output units and not 'accounting' units.)

Basic files belong to the data processing hub, but the methods of updating them are part of a given information flow. O. and M. specialists, who normally report to a company secretary or controller, are part of the line operation which includes total data processing. (Thus it is possible to achieve a much closer link between the people who design routines and those who have to work them.)

Finance, manufacturing, marketing, etc., place demands on the total information centre through the senior administrator to whom it reports. They are responsible for:

—Deciding what information they need to do their jobs properly.
—Reporting well in advance any expansion of their demands on the system.
—Evaluating the information provided by the system.
—Using the information to keep top management advised of developments in their special areas.
—Directly controlling a 'domestic' staff to maintain specialized records and to service the professional staff.

Commonplace in ten years?

The hub system described here is only an outline; much detail has to be filled in, and the frontiers of some existing empires have to be breached. For what it proposes is the complete systematization of the company's methods. By separating the 'intellectual' and 'mechanical' parts of each business area, it allows professional men to concentrate on their specialities. They are interested only in the accuracy of the final information and not in the 'mechanics' of producing it.

The setting up of such a system does not depend on the introduction of a computer. But it creates situations in which the powers of a computer can be exploited more fully than they could be under a piecemeal system of business organization.

In ten years' time it may be commonplace. Revolutions have a habit of moving to a climax more quickly than many forecasters realize. *END*

ELECTRONICS

By PETER SPOONER
Editor, 'Business'

Fifth annual progress report on the development and use of digital computing systems by British firms*

THE 1957 progress report summed up the position in these words: *By October this year about* 16 *commercial installations had been made. By October next year the number may rise to four or five dozen.*

In fact this prediction has turned out to be more accurate than most, particularly as electronic data processing is a field where, until recently, manufacturers' representatives joked among themselves that "every inquiry was an order and every order an installation."

The current estimate of about 55 commercial installations excludes, as in previous reports, the simpler types of electronic multiplier or calculator. Of these, between 700 and 800 are now in use.

There are also about 70 so-called 'scientific' computers. Some are working on pure research problems at universities and government establishments; but others are doing 'production' jobs—in such fields as engineering design—for industrial firms.

To give the exact installation figures is difficult because: (1) the position is changing rapidly; and (2) users and prospective users are becoming more reluctant to release information on their ADP plans; and (3) 'Installation' is interpreted in various ways. (It may mean the delivery of equipment to a customer's premises; the passing of an acceptance test; or the point where the equipment does its first 'regular' job.)

Setback in sales. For the computer manufacturers it has been a rather disappointing year. Few of them have sold as many machines as they had expected.

Some have had to cut back their production plans, possibly delaying the delivery of work in progress. Several are faced with slightly embarrassing gaps in their order books.

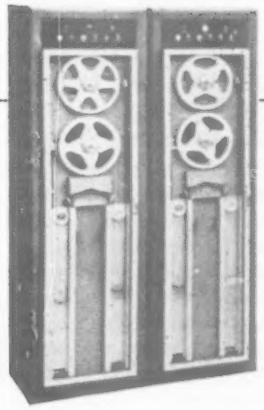
One reason is the financial uncertainty of the early part of the year. Another—probably stronger—is that many prospective buyers have decided to 'wait and see' what the first batch of installations really achieves.

Now it is a buyer's market. About a dozen manufacturers have something hard-and-fast to sell. And as their systems emerge from the development period and are offered on reasonably short delivery, the queues seem, perversely, to shrink.

However, the manufacturers believe that next year will see a different

*Previous reports have appeared in the November issues of BUSINESS Journal of Management each year since 1954. A few reprints of the 1957 report are available, free of charge, on request.

in the OFFICE



story. They are confident that operational reports will do more than anything to coax the many firms who are hesitating on the brink of electronic data processing.

Also they are heartened by a realization that the potential market is bigger than was originally thought. The industrial and commercial giants are not going to be satisfied with one computer apiece; and smaller organizations are rapidly being brought into the picture. Moreover such excellent prospects as the banks, the insurance companies and the nationalized industries are still largely uncommitted.

The first jobs. Most of the present commercial installations have taken over routine jobs which were previously done by punched card or semi-mechanized systems. Few users have broken new ground.

Payroll, of course, is still popular:

Large-volume stores: First reports O.K.

This year British firms have obtained some working experience of magnetic tape and film storage systems. In volume it is not much; but the first reports are reassuring.

Teething troubles were less than was generally expected. The much-quoted 'dust bogy' has in fact caused very few difficulties.

Proof of the pudding is that several firms have already transferred vital commercial records to magnetic tape or film—without bothering to cover themselves by running punched card or other records in parallel.

Three British computer manufacturers have now put large-volume magnetic stores into the field.

National-Elliott have 11 installations (listed on page 41) of their unique film storage system.

IBM United Kingdom have three tape installations (at the U.K. Atomic Energy Authority, Aldermaston, ICI Paints Division, and Rolls-Royce).

Ferranti have one in Britain (ICI Dyestuffs Division) and one abroad (Svenska Flygmotor, Sweden). For these they have used American-built ElectroData tape machines.

Theoretically one of the big advantages of tapes or films is that the record information on them can be updated by erasing and rewriting. In fact the usual practice is to transfer both changed and unchanged data to a new tape or film as each computing run is made.

This reduces the danger of vital records being lost because of faults in the rewriting system. If the new tape is garbled, the user still possesses the cumulative records produced during the previous run, plus the current data on punched tape or punched cards. Therefore the routine can be repeated when the fault has been put right.

As a further safeguard, the user can adopt 'three generation' working—holding each tape or film intact until the next *two* updated tapes have been produced satisfactorily.

it figures in the programmes of at least 30 per cent of the firms which have ordered or actually got computers. But the records maintained by BUSINESS show that more and more attention is being paid to such operations as production planning, production control, inventory control, material scheduling and costing, order processing, sales analysis and sales forecasting.

Efforts are now being made to 'integrate' some of these—and it is there, perhaps, that computing systems will find their most profitable uses during the next few years.

A few companies have begun to apply statistical or operational research methods to day-to-day business problems. However it would be unrealistic to expect immediate advances in this direction. Computer users have clearly chosen to walk before they run.

Three facts emerge from a rather jumbled picture:

1—The average installation is grossly under-worked at present. Some machines operate productively for only about ten hours a week (out of a potential 100 hours or more!). Yet even they are on the point of proving to be good investments, allowing for the fact that a large proportion of the initial programming and systems re-organization is usually written off against further developments. Case-histories in the June 1957 and June 1958 issues of BUSINESS show that savings can be made when a small computer takes over one or two fairly simple jobs. Much bigger rewards await the firms which manage to develop 'integrated' systems.

2—Britain, like the USA, has already produced its computer 'failures'. At least two expensive installations are temporarily under dust-covers—although they are composed of equipment which is being used successfully by other firms.

3—It is now apparent that, in the past, too arbitrary a distinction has been drawn between 'scientific' and 'commercial' installations. Some of the former are doing things which are strictly commercial in purpose; and before very long some of the latter will be applying mathematical or scientific principles to matters which directly concern general management. For this reason it is better to classify the bulk of the present commercial work as 'clerical'.

New equipment. Five new British computers have been announced this year: *Elliott 802*, *Emidec 2400*, *Hollerith 1400*, *Metrovick 1010*, and *Pluto*.

Two of these are in the high-price range. It seems, however, that manufacturers have come to the conclusion that there is only a very small market in Britain for installations costing more than £250,000. So despite the softening of dollar import restrictions, there is not likely to be much competition from such large American data processing systems as the *Univac II*, the *IBM 700* series, the *Burroughs 220* and the *National 304* (although IBM are to supply a *705* to the Royal Army Pay Corps and have installed four machines of this series on the Continent.)

Much of the current development is concerned with peripheral equipment, notably high-speed output printers. Two fundamentally different achievements in this field (by Creed and Rank Precision Industries) are being shown at the Electronic Computer Exhibition as 'experimental models', obviously to test the response of potential users. At a more advanced stage are:

—The Decca twin-tape magnetic storage unit.

—The Ferranti magnetic tape-to-printer converter system (already installed).

—The Solartron Electronic Reading Automatum (due for delivery in three months).

'Integration' medium. There is a rapidly developing interest in punched paper tape—once dismissed as too slow for extensive use in commercial data processing systems.

Creed have introduced a new output punch which is ten times as fast as any available hitherto. The first batch of production models has been sold to a number of computer manufacturers.

Many office equipment firms are developing the ideas of (1) transmitting computer data by telegraph; and (2) punching tapes as an automatic by-product of conventional typing, calculating or book-keeping operations. This particular concept of 'integrated data processing' has been grossly over-simplified: for example, people talk blithely about

What they cost

- *Basic cost of a computer with minimum input and output facilities ranges from about £20,000 to £80,000.*
- *The addition of large-volume storage and fast output printing doubles or even trebles the basic cost of the computing unit. Average for a 'complete' installation of this sort is about £150,000. To date, no commercial installation in Britain has exceeded £250,000.*
- *The most expensive commercial data processing system to be developed in Britain is the Ferranti 'Perseus.' But the first two installations are going abroad.*
- *Costs show signs of rising. Basic computers are affected less than input, output and storage equipment.*
- *Computer manufacturers generally offer their systems on rental terms as well as for outright purchase.*

the 'common language' medium when there is in fact a regrettable lack of standardization in punched tape codes. But it is plain that something pretty useful will be left when the extravagant claims have been washed away.

What the manufacturers have achieved this year

As usual, this survey concludes with a short report on the progress made by each of the manufacturers of digital computers and associated equipment.

▶ The first *National-Elliot 405* system—at the City Treasurer's Office, Norwich—has been working well since April 1957. During the past 12 months it has been joined in the field by 11 more installations. All but one of them have magnetic film auxiliary storage, the unique system to which the manufacturers are now firmly wedded.

National Cash Register Co. Ltd., say that another dozen firm orders, some from abroad, are in the process of execution.

Current users of their £100,000—£150,000 data processing system include: ICI Nobel Division; the National Gas Turbine Establishment; Unilever; the Board of Trade; Littlewoods Mail Order Stores; British Insulated Callenders Cables; the National Research Development Corporation; Newton Chambers; Albert E. Reed; Radio Rentals; and the North Western Gas Board. The jobs which they are doing initially range from payrolls (at least four of these) to linear programming and scientific work on turbo-jet formulae.

Because of their success with the magnetic film store, NCR's marketing policy has been to concentrate on large-volume paperwork operations. Although they recognize the potential value of 'new' applications—for example, in operational research and the more advanced forms of management-by-exception—they believe that computer work should normally start with a clearly defined, large-scale job (e.g. payroll or stock control) and then develop into a fully integrated system.

The *405* installation at their head office has been used mainly for demonstration and the 'debugging' of programmes for prospective users. However, a second machine—to be installed next year—will undertake service bureau work.

▶ The *National-Elliott 405* is made by **Elliot Bros. (London) Ltd.** This old-established electrical engineering firm also make—and market themselves—two comparatively small scientific machines, the *402E* and the *402F*, at least ten of which have been installed.

Now they are introducing the *802*, which uses printed circuits, transistors and magnetic cores, and is not much bigger than an office desk.

Apparently the new machine has prospects in business as well as scientific data processing. A similar computing unit is being used in the *Type 609* process information system developed by another member of the Elliott-Automation group—striking evidence of the 'universality' of electronic data processing equipment.

▶ In April—four years after the inauguration of J. Lyons & Co.'s 'electronic office'—the first production model of *LEO II* left the London factory of **Leo Computers Ltd.** It has been installed by Stewarts and Lloyds at Corby. Initially it is doing payroll, but more ambitious jobs are being programmed for it—including an ore-scheduling procedure which combines linear programming techniques with day-to-day production control.

Another machine was installed in September by the Imperial Tobacco Co. Ltd., W. D. & H. O. Wills Branch, at Bristol, where it is to carry out a series of comprehensive invoicing, credit control, accounting and statistical jobs. The most powerful *LEO II* built to date, it incorporates the *Samastronic* printer, and *Ferranti* magnetic drum auxiliary storage.

This leaves three machines in various stages of assembly at the factory. They are for:

—The Ford Motor Company Ltd. (spare parts invoicing and stores control). This machine is now undergoing final acceptance trials.

—Leo Computers' own data processing service (to supplement the *LEO I* and prototype *LEO II* already in use).

—The Ministry of Pensions and National Insurance, Newcastle (for payroll, wages accounting and statistics).

The service machine will be the first to incorporate magnetic tape storage (Leo Computers are using *Decca* equipment). Some details of their service work appear in the

EMIDEC 2400—now being built by E.M.I. Electronics Ltd.—is the biggest of the five new data processing systems to be announced this year. The project is sponsored by the National Research Development Corporation.

article on pages 50 to 54 of this issue.

The cost of an installation varies between approximately £110,000 and £180,000 according to the equipment supplied.

Leo Computers are still working on a method of automatically 'reading' original documents. This appears to be a cross between electronic scanning (not character-recognition) and mark-sensing.

▶ Since November last year, **The British Tabulating Machine Co.** have delivered about 20 *Hollerith Hec* computers. This means that about 30 of these small, low-priced machines are either in use or in the process of being installed.

All of them are *Hec 4's* or *Type 1201's*. The first delivery of the Type *1202*, which has much larger magnetic drum storage, will take place in mid-1959.

Many of the current machines are being employed on payroll, but there is also a number of statistical or scientific applications. On a *Hec* computer at one of their Letchworth factories, BTM are developing an advanced system of integrated production planning and control.

The company have now begun to release information on a new and considerably larger machine, the *Type 1400*. This will probably be ready in 1961. Unlike *Hec*—which is an all-punched-card machine—it will use various input/output/storage media. Installations will cost between £100,000 and £150,000.

The joint effort by BTM and the Laboratory for Electronics, Boston, Massachussets, produced a big computer called *Diana*, the most interesting feature of which is a very large capacity file drum. This machine is now at BTM's Research Laboratories, where further experimental work is being carried out on it. Meanwhile the drum—its main commercial legacy—is being developed as a form of random-access storage.

Nothing has emerged from Computer Developments Ltd., set up in 1956 by BTM and GEC. Something *may* do so next year. At a guess, this jointly-owned development company is working on data processing equipment in the lower-price range.

Meanwhile, BTM are still selling plenty of their electronic calculators and multiplying punches, some 500 of which have now been installed. The latest of the line is the *555*—virtually a 'plugged-programme computer'. Half-a-dozen of these have now been delivered to users in Britain and Australia.

The proposed merger between BTM and Powers-Samas should be finalized early next year. How it will ultimately effect the two companies' development and marketing policies—and also their respective lines of electronic equipment—remains to be seen.

▶ Since last year's survey was made, **IBM United Kingdom Ltd.** have installed three *IBM 650* computers. The total is now eight, including the *650* at their London data processing centre.

The new installations are:

—National Coal Board (costing and payroll).

—A. C. Nielsen Co. (market research calculations and analyses).

—Cheshire County Council (costing and payroll).

All of these are 'basic' machines. The only *650's* with magnetic tape storage are at ICI Paints Division (factory costing and material control) and Rolls Royce (scientific work, parts scheduling, material control, cost records, etc.).

Four of the present batch of installations were built at the company's Greenock factory.

There is still only one of the big American-built machines in Britain: the *704* at the United Kingdom Atomic Energy Authority, Aldermaston. This is to replace shortly by a *709*. In just over two years' time, IBM are to supply a *705* (approximate cost: £750,000) to the Royal Army Pay Corps.

Recently the company have announced two new machines:

Eleven of the 12 National-Elliott 405 systems now installed in Britain use the manufacturers' unique method of storing large quantities of data on 35mm. magnetic film. Left-hand picture shows an operator loading a film magazine into the 'memory' unit.

(1)—The *7070* fully-transistorized data processing system, which is designed for either commercial or scientific use, and lies between the *650* and *700* series, and (2) the *Type 628* magnetic core calculator, with control panel programming giving up to 160 programme steps.

During the past year IBM have made big reductions in the purchase prices and rental charges for their electronic equipment—up to 30 per cent in some cases.

▶ The number of *Deuce* installations has risen from 12 to 22. This includes five machines which the **English Electric Co.** are using themselves—three in their Stafford and London service bureaux.

Among the outside users are: The National Physical Laboratory; The Royal Aeronautical Establishment; Bristol Aircraft Co. (who installed a third *Deuce* this year); Short Bros. and Harland; British Petroleum Co.; New South Wales University of Technology; The Central Electricity Generating Board; and Glasgow University.

Initially the emphasis was on the aircraft industry; now it is swinging towards nuclear power and other industries. Most of the machines in use are doing mathematical and engineering design work, but soon there will be some strictly commercial installations.

English Electric's policy is geared to the belief that one computer can satisfactorily handle both classes of work if the right peripheral equipment is available. Current developments in this direction—consolidated by the introduction of a Mark 2 version of *Deuce*—include: magnetic tape auxiliary storage; the ability to use all 80 columns of the punched card input and output; and a 'buffer' system for storing information until it is needed for computation.

One of the first magnetic tape machines will be installed at the company's Stafford works, where systems studies are now being made in such fields as payroll accounting and production control. Another is to be delivered to the Norwegian Bureau of Statistics.

Up to four twin-deck *Decca* units can be coupled to one *Deuce* computer. A full complement of tape units raises the cost of an installation from the basic £49,000 (with minimum punched card input and output) to about £120,000.

Some eight *Deuces* are now on firm order or under construction. Soon English Electric expect to be producing one per month.

▶ **Ferranti Ltd.** have delivered 37 computers—more than any other British manufacturer—although only two of them are commercial systems. The current scoreboard is as follows: 22 *Pegasus* computers (ten more than last November); nine of the original *Mark* 1* series, and eight *Mercury* scientific computers (which have now superseded the *Mark* 1*).

Soon to be delivered are the two *Perseus* data processing systems which Ferranti have built for insurance companies in Sweden and South Africa.

The two commercial systems in use at present consist of *Pegasus* computers with magnetic tape storage units supplied by the Electro Data Division of the American Burroughs Corporation. Users are ICI Dyestuffs Division and Svenska Flygmotor, a Swedish aircraft manufacturer. In the magnetic tape systems, new 'converter' equipment translates data from one form to another independently of the computing operations.

Ferranti are greatly interested in commercial work, despite the success of their machines in the universities, the aircraft industry and other scientific fields. The current programme includes development work on:

—*Pegasus:* a new version is about to materialize.

—*Perseus:* soon to be marketed in Britain at a cost of approximately £300,000.

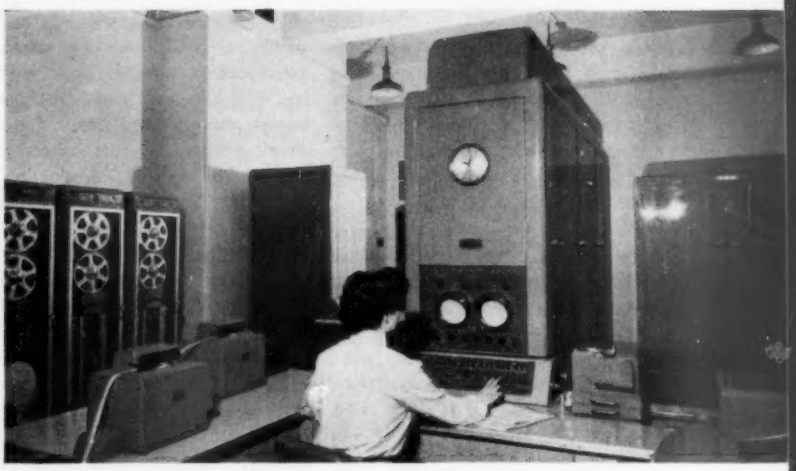
—Direct punched card input systems, using all types of card.

—The attachment of high-speed tape punching equipment.

▶ From **Powers-Samas Accounting Machines Ltd.** comes a new data processing system called *Pluto*. Larger and more versatile than the original *Programmed Controlled Computer*, it is a result of collaboration between Powers and Ferranti (announced in 1954).

Deliveries of the *PCC* are beginning to gather momentum. At the end of October this year, six were either installed or on their way overseas (to Australia, Germany and France). Moreover, Powers anticipate that the total number of deliveries will have risen to at least 26 by the end of December. They

The first commercial installation of a Pegasus computer with magnetic tape storage and tape-to-printer converter equipment. Right-hand picture: One of the features of the new version of Pegasus is this magnetic drum, with nearly double the storage capacity of the earlier type.



now report that about 120 orders are outstanding.

One of their major contributions in the ADP field is the *Samastronic* high-speed output printer, available with or without tabulating unit. This is figuring in computer installations made by several manufacturers.

The company's current programme includes work on: improved methods of input and output; the development (with other firms) of a new, low-priced computer valve with the speed of a transistor; and a new high-speed printer. Presumably these activities will be dovetailed with development work by the British Tabulating Machine Co. when the proposed merger is finalized.

▶ The computer policy of **Burroughs Adding Machine Co.** is in a state of flux—largely because of the recent softening of dollar import restrictions.

The American-built *E101*—a small scientific and statistical machine with pinboard programming—was introduced to the British market about 18 months ago. Since then two have been installed: one by the Gloster Aircraft Co. (for aircraft design) and the other by British Petroleum (for oilfield calculations).

Much development has gone into the *E101*, which can now be fitted with punched tape or punched card input and punched tape output. The basic price of £16,400 may rise, with ancillary equipment, to about £20,000. Plans to manufacture this machine in Britain have been scrapped, but a French-built version should be available here by 1960.

In the States the Burroughs Corporation market two large-scale data processing systems, the *205* and the recently-introduced *220*. Technically, these are 'available' in Britain, but it is unlikely that either of them will be installed here for some time. The British company summarize their current policy by saying that 'they are seeking orders for the *E101* and are prepared to take firm orders for the bigger systems.'

▶ **Standard Telephones and Cables Ltd.** say that they are now making *Stantec-Zebra* computers at the rate of 'seven or eight per quarter' and can offer delivery in under six months. A small number of these low-priced machines are already in use in Britain and overseas. Applications, mostly scientific, include the analysis of data from aerial survey photographs and also aircraft design calculations.

For J. Bibby and Sons Ltd. a *Stantec-Zebra* is doing 'industrial mathematics' concerning the optimum use of currently-available raw materials in animal feedingstuff mixes.

No further information has been released on the large-volume external storage systems which may eventually make this computer more suitable for routine commercial work.

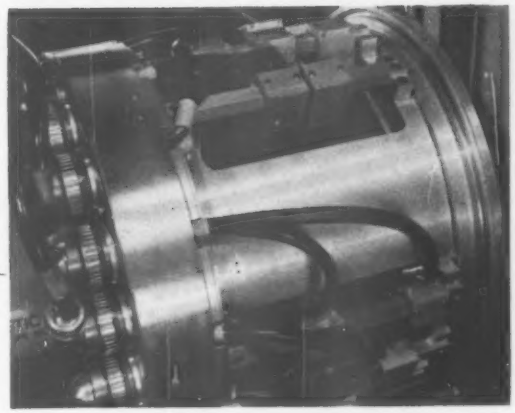
▶ **Metropolitan Vickers Electrical Co. Ltd.** quote a six-month delivery period for their low-priced scientific and mathematical computer, the *Metrovick 950*. A few machines of this series have been installed.

Now the company are developing the *1010*, a larger and more versatile computer for 'data processing and real-time process control'. This is at an 'advanced design stage' and the first production model may be ready by mid-1959.

The *1010* has a large magnetic core store, backed by two types of magnetic drum. Various ancillary units can be coupled to it, including the *Samastronic* high-speed output printer and the *Decca* twin-tape storage unit. A unique feature is its 'data scanner', which transfers information between the fast-access store and all ancillary equipment.

Junction transistors on printed circuit boards are used throughout. The result is a notable reduction in size: the basic computing unit, including working store and control desk, takes up only about 16 square feet.

▶ Unlike the other computer manufacturers, **E. M. I. Electronics Ltd.**



have had to sell on 'futures' during the past year. Their score, nevertheless, is five *EMIDEC 1100* systems.

The first, for the British Motor Corporation's order procedure between their factories and distributors, will be made next Spring. Another machine will be used for demonstrations and for some aspects of the clerical work of the whole of the Electric and Musical Industries' group.

The next installation, scheduled for next Summer, will be at Boots Pure Drug Co., Nottingham. This will process branch orders and maintain a perpetual inventory of the 60,000-odd lines stocked by Boots' warehouses. After it will come machines for:

—Glaxo Laboratories (invoicing, home sales accounting and statistical work).

—ICI Plastics Division (invoicing, stock control and distribution procedures).

From their late start in the digital computer field EMI have drawn the advantage of being able to exploit fully such 'new' components as printed circuits, transistors and ferrite cores.

Also under construction at the company's Hayes factory is *EMIDEC 2400*, a more advanced data processing system said to be capable of 'handling the clerical work of the largest organizations in Britain'. This project is being sponsored by the National Research Development Corporation.

For the *EMIDEC* 1100 machines the purchase price, including one year's maintenance, ranges from £100,000 to £200,000. EMI are also prepared to supply machines on a rental basis under a three- four- or five-year contract.

▶ There is no further news of developments by the Univac Computer Division of **Remington Rand Ltd.** It seems that during the past year this company have continued to make systems investigations into potential applications of their medium-sized *Univac File-computer*.

▶ **Solartron Electronic Business Machines Ltd.** have been concentrating on the *ERA* electronic reading automatum, first demonstrated in February last year. Within three months a production model is to be delivered to the Nottingham head office of Boots Pure Drug Co. There it will read printed tally roll information prepared by special cash registers at branch shops, and will feed this into a custom-built analyzing computer supplied by Elliott Bros.

The *ERA* set-up will be complementary to Boots' *EMIDEC* order processing system. For the time being there will be no ADP link between them.

▶ **Decca Radar Ltd.** have made good progress with their *Type 3000* twin-deck magnetic tape storage unit. This is being supplied to several British computer manufacturers, and orders have also been received from the Continent.

The ½in. tape travels at 104in. per second; can be stopped, started or reversed in less than 10 milliseconds. Capacity of a 3,600ft. spool is 33 million binary digits.

Decca say that they are now working on new developments in digital computing.

▶ As the largest British manufacturer of punched tape equipment, **Creed and Co. Ltd.** have had a stake in ADP since its early days. Now they are introducing new machines designed specifically for computer output systems. These include:

—A high-speed tape punch which works at 3,000 words per minute.

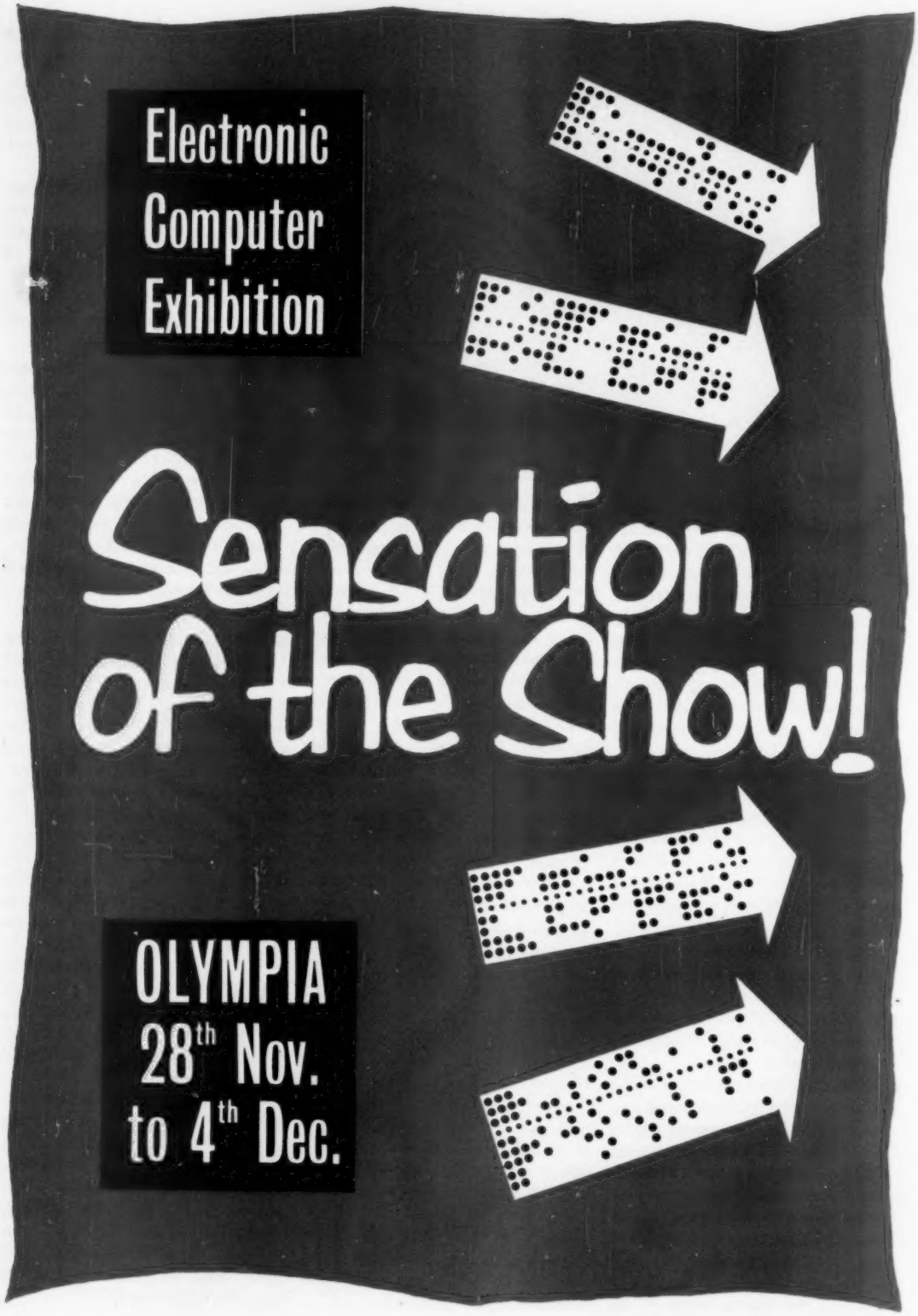
—An experimental tape-operated printer (mentioned earlier) which works at 1,000 words per minute.

▶ Last year the president of the American Haloid Corporation forecast (BUSINESS, August 1957, page 65) that xerography, the new electrostatic reproduction process, would be used in computer output systems. Since then their British associates, **Rank Precision Industries Ltd.**, have built an experimental model of a 'revolutionary' high-speed printer.

It works non-mechanically. Output information is 'written' on a cathode ray tube. From this it is instantaneously copied by a *Copyflo* xerographic unit.

The experimental model prints 1,500 lines per minute. In production models, this may be doubled. The results of development work by Haloid suggest that even higher speeds are practicable.

Whereas mechanical output printers produce multi-part sets of forms by using pre-printed continuous stationery interleaved with carbon, the xerographic unit makes either two or four copies side by side. Production models will be 'programmed' to print forms simultaneously, thus avoiding the use of pre-printed stationery. *END*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TELEGRAPH HOUSE · CROYDON · SURREY

Low-cost computing may speed up product research and development

Analogue Machines Solve Many Problems

By R. FATEHCHAND B.Sc., Ph.D., *Computational Laboratory, Birkbeck College*

INDUSTRY has at its disposal two basic types of computer: digital and analogue. Their applications are complementary rather than competitive.

It is the digital machines which, because of their versatility on general-purpose data processing, have got such spectacular publicity. But analogue computers—generally simpler and much cheaper—are being used increasingly and are proving invaluable in the fields for which they have been designed.

Broadly their main applications are in:

—Industrial research.

—Product design and development (including simulated testing).

—Process control.

As calculating devices, they are used primarily for the speedy solution of differential equations. In a matter of minutes (sometimes seconds) an analogue computer can get the answer to mathematical problems which might otherwise take weeks to solve. Thus a firm which uses one may be able to make big savings in development costs and time.

However, digital computers can also solve long and involved mathematical problems in a tiny fraction of the time which would be taken by a mathematician with an ordinary desk calculator. What, then, are the fundamental differences between the two types of computer?

Where they differ

Both accept information (usually numerical), perform arithmetical calculations on it, and present the results to some convenient output device. But they do these things in very different ways.

With analogue computers, the 'components' of the problem are translated into physical quantities as—for example, shaft rotations or voltages. Today nearly all analogue machines simulate problems electrically (that is, the problem's component parts are represented by a number of electrical quantities such as voltage or current) though the same thing can be done mechanically.

With digital computers, as the name implies, the numbers are operated on directly in their digital form, and are represented by discrete events such as electrical pulses.

Thus, while analogue computers handle continuous processes, a digital machine deals only with numerical quantities as finite numbers of significant figures.

Since digital machines are more accurate and can do both commercial and scientific work, it might be asked why analogue machines are used at all. But apart from their much lower cost, they have the following advantages:

1—The operational speed on certain calculations where the variables are dealt with simultaneously can be much higher than is reasonably possible with a digital machine.

2—No highly-trained team of programmers is needed, as with a digital machine.

3—The high operational speed enables the machine to simulate, on a 'real' time-scale, short-duration problems such as the flight of missiles. Thus, one second of the missile flight would correspond to one second in computer operation time.

4—The 'real' time-scale operation enables actual parts of the system under test to be incorporated in the machine.

5—The machines are working models of the problems under study, and as such provide physical insight.

What they are doing

The following examples give some idea of the wide range of uses to which analogue computers are being put. (Other fields where these machines are being used increasingly include petroleum plants and the nuclear power industry).

SYNTHETIC ROAD TESTS

A general-purpose analogue computer by Short Brothers and Harland Ltd. is being used in the Technical High School at Brunswick for research work on the effect of uneven road surfaces on projected vehicle suspension systems. Aim of this research is to help the German car industry to determine the type of suspension system best suited to the needs of new lorries and heavy haulage vehicles.

Method used is to give the computer an equation in which such factors as the type of axle, suspension and chassis, and also the different types of bumps and depressions on the road surface, are represented by various electrical voltages.

When the simulated suspension system is 'driven' over the bumps, a trace on the computer's cathode ray tube indicates the actual movements of the chassis and axle arrangements. By manipulating certain switch controls, research workers can change such values as the stiffness of the suspension springs, pressure in the tyres, or damping of the shock absorbers, until a system is found which gives the best over-all results.

The computer does in an hour a job that would normally take weeks. Also the results obtained are far more accurate.

AIRCRAFT CALCULATIONS

Short Brothers are also using their analogue computers to solve problems on the aircraft manufacturing side of their business. Examples concern wing flutter and dynamic analysis.

TRAIN PERFORMANCE

The British Transport Commission have installed an analogue computer in the office of its Chief Electrical Engineer (shown in the photograph on the opposite page). This will handle problems of acceleration, deceleration, speed, time and distance, and so give advance details of train performance with the new forms of motive power being introduced under the railway modernization programme.

This information will be used to compile revised time-tables, designed to make the maximum use of diesel and electric trains. The computer can also provide details of the current consumed and, most important, give the designers of the motors some indication of the temperatures likely to be attained by such equipment.

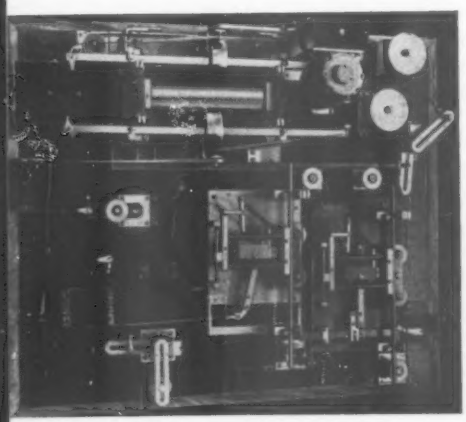
What they cost

One respect in which an analogue computer compares favourably with the digital type is price. Most standard models cost between £1,500 and £6,000, whereas the cost of a complete digital installation may be £100,000 or more.

For example, the *Minispace* analogue computer made by the Solartron Electronic Group Ltd. comprises ten drift-corrected D.C. amplifiers with all the necessary input and feed-back components, potentiometers, control panels, etc. and costs £1,500. Larger analogue machines made by Short Brothers and Harland and English Electric cost between £5,000 and £6,000. Special-purpose installations may reach the digital computer price-range.

In general, the cost of analogue computers is related to the number of amplifiers in the circuit of the machine, but most models can be enlarged on the 'building brick' principle, whereby two or more units are connected together as required.

The flexibility of the equipment varies with the design. Broadly there are two ways of operating analogue computers. With the first, the elements of a problem are set up on the control panel by the positioning of various switches. The second method makes use of patch panels and trays which can be removed from the machine and replaced with others on which different problems have been set up. *END*



GETTING IT TAPED. Analogue systems can be built from mechanical as well as electronic components. Air Trainers Link Ltd. supply kits of parts and also offer an advisory service on their use. The parts—interconnected by steel tapes—can be assembled into working models of a variety of mathematical problems.

Computer Time-hire Services

WHAT THEY DO · HOW TO USE THEM

BY ALAN PETERS

SOME time ago a man walked into a computing centre with a 'foolproof' racing system. Would they test it? The centre did—and found several flaws. Thus, by spending a relatively small sum, its originator avoided what might have been a disastrous investment during the next racing season.

This example of mathematical data processing—with a strong commercial motive—shows that the potentialities of computer time-hire services are much wider than many businessmen assume.

Between the production of routine paperwork and the solution of esoteric mathematical problems there is a rich and still largely undeveloped field. For even a simple 'yes' or 'no' answer may be worth more to a client than masses of printed output.

A pipedream—still unfulfilled

The idea of service bureaux caught the imagination in the early days of electronic computers. Then it was widely forecast that they would cater for the business firms which were unable or unwilling to install machines. Each centre would electronically process stock records, sales records, payroll information and other 'raw material' from a number of businesses.

Today, after five years' working experience in Britain, the 'service' picture is quite different. The pipedream concept of co-operative business data processing may

Ferranti's data processing service is based on a Pegasus computer. Like other centres, it handles both scientific and commercial work for a variety of clients

develop in time; it is only recently that suitable equipment has become generally available. But at present the accent is on one-shot and other special jobs in the scientific, engineering and statistical fields.

Nevertheless this does not mean that most of the current service jobs are concerned with non-profit-making laboratory research; or that there are no strictly commercial opportunities for the 'ordinary' business.

How the services began

The first computing services (apart from the Lyons 'electronic office') were set up by large electrical engineering firms: Elliott Bros., Ferranti and English Electric. They started by doing a lot of work for their own organizations, and were naturally inclined to concentrate on basically similar work for others. It was, after all, a period of experimentation — of learning how to use computers.

These origins are still apparent. Much of the work of English Electric's two centres is concerned with aircraft, electric traction problems, and the design of large electrical equipment. Ferranti's centre spends a good deal of its time on work for the aircraft industry. Elliott Bros. are leaving routine commercial jobs to their associates, the National Cash Register Co.

Of course, there are big opportunities in the use of digital computors on plant or product design and performance-rating. Nor are these restricted to 'big' projects. Recently one service bureau computer was given the task of designing springs for its own magnetic drum. Other, more typical jobs in this category are:

— Simulation of the performance of electric trains pulling loads over specific routes.

— Investigation of the long-term performance of nuclear reactors.

— Engineering calculations on pipe stresses, frame stresses, etc.

— Studies of water flow connected with the Thames Barrier project and other hydrological schemes.

— Calculations concerned with the performance of roll-damping fins for ships.

— Investigation of the effects of vibration in beams.

— Design work on transformers and other electrical components, chemical plant, oil refining plant, etc.

Scope for business maths

Since the early days the range of work has broadened considerably. More use is now being made of statistical techniques in such diverse fields as:

— B.B.C. listener research.

— The computation of premium tables for insurance companies.

— Investigation into the relation between coal dust and pneumonicosis (for the National Coal Board).

— Quotation work concerned with company pension schemes.

— The rationalization of railway freight charges.

— Railway timetable calculations (at least two computing centres have had a hand in this).

— An official survey of professional salaries (the results of which were published last month).

— Football pools forecasting.

From statistics it is a short step to 'industrial mathematics,' the new 'science' which Lord Halsbury has forecast will become commonplace and virtually essential by 1977 (and which, because of fast developments in ADP, may beat his Lordship's target date).

Most of the computing centres have undertaken jobs involving operational research techniques. For example:

Simulation has been used for product design, performance-estimation, long-range production planning, etc.

Linear programming has been used to solve transportation and distribution problems, work scheduling problems, etc., and to ensure the optimum use of raw material or manufacturing facilities.

In this field many people foresee the most profitable uses of computing services (and, indeed, of company-owned computers). It is better, they claim, to do something entirely new than to try to improve jobs which can be done satisfactorily by either manual or mechanical methods.

Remember that there is a strong affinity between such jobs as railway timetable calculation (where the aim is to organize the traffic

From the production of routine paperwork to the solution of mathematical problems, there are opportunities for businesses of all types and sizes

most efficiently on the available routes) and production planning (where the aim is to get the most profitable flow of work through the available plant). O.R. techniques are of universal application: and computers offer, for the first time, universal data processing facilities.

When a company buys time on a computer it has the choice of doing the programming itself or getting the service bureau's expert programmers to do this.

Clerical work by proxy

One reason why engineering design and similar jobs have dominated the scene is that in some respects they are easier to programme. A computer does arithmetic. The mathematics of the job is done by humans before the instructions and data are fed into the machine. Thus it often happens that a service job in the scientific field is only a faster way of doing something which is already being done — and doing it, moreover, in much the same way as before.

Clerical data processing, on the other hand, involves a lot of planning and reorganization in the 'make ready' area. Programming extends beyond mathematics into business systems. It has to be geared to the needs of a specific firm. That is the more realistic side to the original concept of co-operative data processing services.

Nevertheless there have been some striking developments in this direction — striking in their own right, and also as a foretaste of things to come.

Starting at the 'payroll level,' the pioneering work has been done by LEO. This installation was designed to handle routine commercial jobs for Lyons, including payroll and the processing of daily orders from teashops. By December 1955 it had begun systematically to take over a 23,000-strong payroll for an outside organization — the Ford Motor Company, Dagenham. Employees' time-cards arrived at the centre on Saturday morning and were processed over the weekend; printed payslips and summaries were delivered to Ford on Monday morning. Standing information and updated records were held at the centre.

Later LEO began to service the Stewart and Lloyds payroll in much the same way. (This job has now been transferred to the client's own machine.) Now the centre is handling similar work for three business firms, apart from Lyons and Ford, and one local authority. None of these new payrolls is vast: *in fact the smallest concerns fewer than 1,000 employees.* The clients are Tate and Lyle, Telfers, Kodak, and Greenwich Borough Council.

LEO is also doing other regular commercial jobs, including

— A van sales and stocks control system for the Ever Ready Co.

— Group pension scheme renewals for the Eagle Star Insurance Co.

These are in addition to their one-shot statistical jobs.

No other computing centre has handled an outside payroll on a regular service basis. However, there have been notable developments in such fields as production control.

Samples:

1—The IBM data processing centre produces parts breakdown lists for Belling and Lee whenever production plans are changed in the light of market conditions. This is estimated to have saved many thousands of pounds within a few months. (The job began after the company had seen a demonstration procedure at the centre.)

2—The English Electric computing centre at Stafford is producing weekly manufacturing schedules for a 600-employee knitwear firm in the Midlands. The computer even prints out machine-setting instructions for the operators, thus replacing to a large extent traditional skills and judgment. Again, big savings are expected.

The balance between so-called 'commercial' and 'scientific' jobs is likely to change in future when the centres become equipped with large-volume data processing systems. At present it is difficult to produce breakdown figures. Some attempts are made to classify current service work, but they are usually misleading. This is because the pattern is irregular; at one centre, for example, commercial jobs may take up 30 per cent of the computing time one week, and about 3 per cent the following week. Moreover, at most centres there are fluctuations in the amount of time which is spent on non-service work, including training and demonstration.

Why some firms hold back

Several hundred organizations have already bought time on computing centre machines. One fact which does emerge is that most of them are very big. This is understandable; but it is inclined to discourage smaller organizations.

Some potential users are held back by an uneasy suspicion that

The LEO computing centre is at present the only one that handles several routine clerical jobs on a regular basis. This work has sprung from experience with the original 'electronic office' set up by J. Lyons and Co.

once you cross the threshold of a computing centre the high-pressure selling begins. Their suspicions are wrong. You don't have to order a computer before you can buy time on one. The centre knows that a user often visits its competitors to get experience on their machines as well. That is inevitable and desirable; the whole business is a process of experimentation.

How to use a service bureau

Use of a computing service generally begins with one or two specific problems, not with an attempt to put a complete system on to a computer. Each problem must be defined—the prospective user must know exactly what he is trying to do. There is a case on record of one firm having a statistical analysis done 'according to the book' and on being presented with the results asking what they meant. The firm did not understand what it had had done. Neither did the computing staff.

At a strictly practical level, here are the main considerations for a firm which has never used a computing service.

Where to go. Services are offered by most computer manufacturers, as listed on page 54. In addition, it is possible to buy time on some university machines and also on those which are now being installed by leading technical colleges. Later, a few industrial associations may acquire computers and handle service work for members: BISRA (the British Iron and Steel Research Association) are the first in this field, with a recently-installed *Pegasus*.

Methods of working. Broadly, the client has the choice of:

1—Programming the work himself.

2—Getting the centre to do this.

3—A co-operative effort by his own staff and that of the centre.

All the centres do, in fact, have their own programmers and offer a a consultancy service. Like consultants in other fields, they have the advantage of being able to draw on a wide (and fast-growing) range of experience; and the disadvantage of being less familiar with the clients' work and specific problems than the client himself.

Also they maintain the same sort of professional code as other consultants. The client need not fear that confidential information on his products or plans will fall into the hands of competitors. Programmes developed specifically on his account will not be published or made available to others without his consent.

The use of this 'full' service involves the client in little effort. It is particularly convenient if his problem is a standard one—for example, determining various kinds of stress, finding the 'least cost mix' or solving sets of simultaneous equations. The centre may be able to use a stock programme or to build one quickly from its library of 'sub-routines.'

If, on the other hand, the client wants to solve the problem himself, he must learn how to use a computer. This is by no means a formidable task. Often it is easier for the client to learn computing than for the computer staff to understand the client's problem. Where a firm has difficult problems—or a lot of problems—the training of their own staff is worthwhile. Indeed, a computing centre is as much a training school as a place for getting jobs done.

Until recently the *only* method of learning how to use a machine was to go on a programming course (as described in the article on page 55). But an important new development is the availability of auto-codes. With these it is unnecessary to write instructions in machine language: the programmer can use a more or less natural symbolic notation learnt in a day or two. Although auto-codes have drawbacks (they do not necessarily produce the best programme), for many purposes they cut the time which has to be spent on this part of the operation and thus bring computers within the reach of many more firms.

One centre, at least, finds that more than 80 per cent of the work which goes on to its machine is programmed by clients. Like many of its competitors, it allows the client's programmers to work on the premises without making a charge for this facility.

Cost. The basic fee is usually in the region of £35 per hour. This

refers to actual computing time, so it is practically meaningless without considering (1) the intrinsic speed of the machine; (2) how quickly a particular job can be done; and (3) the amount of programming and data preparation.

Generally speaking, the faster the machine the higher is the cost of buying time on it. Hence it is impossible, or at least misleading, to draw up a single table comparing service charges.

Of course there are huge variations in the costs of different jobs. Take the solution of simultaneous equations. The actual computing time may be a matter of minutes, or even seconds. Since it is a standard job, a programme already exists at the centre. The client has only to supply the information for his particular problem. This may be written on a standard form, thus helping the computer staff to punch it into the computer medium (for which a small charge may be made). Consequently there is no reason why the total charge should be high. Indeed, some jobs of this sort cost considerably less than the basic charge for one hour of computing time.

At the other end of the scale, the programming of a complex job may take weeks or even months and cost hundreds or thousands of pounds. If it is done by the centre, the charge is usually the subject of an individual arrangement, possibly on the basis of a research contract for a limited sum. The most common practice when the user is tackling his own problem (and thus gaining invaluable experience) is for him to work closely with one member of the centre's staff in preparing the material and running it on the computer.

Whoever does the programming, both instructions and data can be punched at the centre. But some organizations, especially those with a lot of work, find that it pays to acquire their own tape or card-punching equipment. This can be either independent or linked to existing equipment like electric accounting or calculating machines.

For routine commercial work there is also the cost of organizing the system in the first place and regularly handling the data.

Here is the way in which the LEO service calculates its charges:

— The client gets an estimate for programming, based on the time which the centre's programmers are expected to spend on it.

— The programming charge is rendered in the form of a monthly account while the work progresses.

— When the programme is written, a basic charge of £35 per machine hour is made for the job itself.

— In addition, there are separate charges for punching input data (at the rate of about £1 per 5,000 characters) and for the pre-printed forms used at the output stage.

— For all charges a monthly account is rendered as long as the job lasts or a total charge for programming is agreed at the start.

In the early days of service work, manufacturers were inclined to accept jobs at low rates (computer time only) to gain experience in programming and operating. Now most of them try to work strictly on the basis of cost-plus-a-profit-margin, although the actual arrangements vary considerably. Also there is less tendency now to even things out by unloading some of the profit from one job on to others.

Large-scale output. When considering cost, it is worth remembering that a computer system is capable of producing working documents. In a payroll application, payslips may be printed out by a computer-driven tabulator or, as on off-line operation, by a tape-operated electric typewriter.

At one centre, statistical tables which are to have wide circulation are printed straight on to offset-litho masters. *END*

AT YOUR SERVICE....

Leo Computers Ltd.

Soon after its installation by J. Lyons & Co. early in 1954, the original 'Leo I' began to take on work for outside organizations. Now most of the service is provided by the 'Leo II' prototype, installed in June 1957. A production model of the same series (but with more extensive input/output and storage) is to be added next year.

Elms House, Brook Green, London, W.6.

English Electric Co. Ltd.

Stafford centre (two 'Deuce' machines) opened early in 1955; London centre (one 'Deuce') in May 1956.

Nelson Research Laboratories, Stafford.
Marconi House, Strand, London, W.C.2.

Ferranti Ltd.

London computing centre opened in 1956. Based on 'Pegasus' computer.

21 Portland Place, London, W.1.

Elliott Bros. (London) Ltd.

Started about five years ago. Now based on two '402' computers (one with floating point) supported by an early 'Nicholas' machine.

Computer Division, Boreham Wood, Herts.

National Cash Register Co. Ltd.

At present their 'National-Elliott 405' data processing machine is mainly engaged on 'test bed' work. But a second machine, to be installed next year, will offer a full service.

206-216 Marylebone Road, London, N.W.1.

IBM United Kingdom Ltd.

Opened in May 1957. Extensive range of electronic and electro-mechanical data processing equipment, centred on an 'IBM 650' computer.

101 Wigmore Street, London, W.1.

British Tabulating Machine Co. Ltd.

The 'Hec' computer at the Hollerith Computer Centre (opened early this year) is used mainly for demonstration, training and experimental work. But the company are prepared to take on selected non-routine service jobs. Later they may offer a full service.

36 Hertford Street, London, W.1.

Recent developments in ADP have created a hard-to-meet demand for all kinds of training. But manufacturers and technical schools are responding to this challenge in a practical way . . . .

Where You Can Gain Computer Know-how

By ROBERT McKINNON

TRAINING courses run by computer manufacturers and technical colleges fall into four main categories: Appreciation for management, and instruction for programmers, maintenance engineers and operating staff.

Management courses are naturally a top priority. Here, the students also can be divided into broad groups:

— People from firms which have already ordered a machine of the type with which the course is primarily concerned.

— People who are actively 'in the market' and find that the best way to assess different machines is to 'go the rounds' of manufacturers' courses.

— People who simply want to learn about computers—with an eye to future developments in their own careers or their own companies.

In the past, top managements were sometimes criticised for not showing enough direct interest. Today there are signs that this apathy is being overcome; but it is still true that specialists and technicians form a large part of the attendance at appreciation courses

Such courses may last anything from one day to three weeks. While there is no strict rule, the length seems to vary inversely with the status of management. For instance, both Ferranti and the British Tabulating Machine Co. run one-day appreciation courses for directors and top management, as well as three-week courses for executives who may have to take an active interest in the installation and use of a computer.

The training content also varies considerably. Understandably, the courses run by manufacturers have a selling angle and are geared to a particular machine, but this does not mean that instruction on the general principles of computing is omitted. Emphasis is placed not only on the advantages but also on the limitations of a computer installation, and also on the vast amount of preparation and reorganization that will be needed before the computer arrives.

These points made, the instruction usually includes a basic description of the components of a computer, and some instruction in the general theory of program-

ming, then the instructor goes on to discuss typical applications. Finally, the 'appreciation' may be rounded off by taking students through an actual case-history of a job which has been performed by the computer in question.

The three-week appreciation course run by the British Tabulating Machine Co. at their recently opened training centre at Bradenham Manor, Essex, is a good example of the way the 'secrets' of a computer are being explained to senior executives. Courses, normally limited to 20 people, begin with a two-day survey of the general situation. No attempt is made to drag students through such technicalities as binary coding, but the instructors have built a wooden mock-up to illustrate the main principles of the calculating, logical and storage units of a computer. To see an actual machine, students are taken to the firm's computing centre in London. Most of the lectures are given by the school's own staff, but towards the end a number of outside speakers are introduced, including the company's service and installation engineers and representatives of user firms.

Universities and technical colleges up and down the country are also active in building up computer training courses. Many of them concentrate on advanced technical matters but a number deal with computers in general and are tailored to the needs of management. Some of the centres where this last type of course is held are:

LONDON AREA

Ealing Technical College.
Hendon Technical College.
Northampton College of Advanced Technology.
North-Western Polytechnic.
Regent Street Polytechnic.
Sir John Cass College.
Croydon Technical College.

OUTSIDE LONDON

Birmingham College of Technology.
Derby and District College of Technology.
Gloucester Technical College.
Leeds University and Leeds College of Commerce.
Leicester College of Technology and Commerce.
Loughborough College of Technology.
University of Nottingham.
Salisbury and South Wiltshire College of Further Education.

This is a select list, but it shows that in many parts of the country educational bodies are aware of the need and the demand for computer appreciation courses. The Birmingham College of Technology, for example, last month began a series of one-day conferences on digital computers and their industrial applications. The syllabus at the first of these was:

> A survey of the components of a computer and their functions; the philosophy of Ferranti computing systems for commercial, industrial and scientific work; commercial and industrial applications, with special reference to stock recording, material control and production planning; and mathematical and scientific work on computers in the field of research, engineering and design.

One of the chief centres for computer instruction is the Northampton College of Advanced Technology. Among its most popular courses are 'summer school' for management. At first only top management attended these courses, but now they draw large numbers from middle management. Said a spokesman of the College recently: "*Managements are now beginning to realise the danger of being left behind.*"

Training programmers

The term 'programmer' is often used loosely to describe a person whose job is concerned with preparing instructions for the machine. But there are in fact several 'layers' of programming:

1—Organizing the work or problem into the best form for the machine to handle.

2—Breaking the problem down into a series of machine instructions.

3—Putting the instructions into machine language.

At the head of the programming team, then, should be someone trained in numerical analysis and, preferably, with a good degree in mathematics. For the second 'layer' a knowledge of mathematics to G.C.E. standard is desirable; while experience has borne out that girls of reasonable intelligence can be trained to do the coding job efficiently.

However, as programmers are concerned with the operating of a computer installation, courses for them are longer and more detailed than those in management appreciation. Different computers require different programming systems and courses are therefore often tailored to a specific machine.

All the computer manufacturers run programming courses, and so also do a number of technical colleges and universities. The Northampton College, for example, runs programming courses for the *Pegasus*, the *Elliott 405* and the Powers-Samas *P.C.C.* The University College, London, runs an annual course on the programming of a small computer while both Leeds University and Leicester College of Technology and Commerce have general courses in programming.

The time for the training of programmers varies with the machine being studied, the nature of the course (whether full- or part-time), and with the level to which students are being trained. Most last at least four weeks; others considerably longer, sometimes as long as three months.

After the trainee programmer has been taught the idiosyncrasies of the machine he will be working on, his rate of progress depends on such considerations as:

— Whether there is a computer on which he can 'practise.' (In this respect, the use of time-hire services may be invaluable.)

— Whether he has an experi-

Courses for programmers are longer than those for general management. At the British Tabulating Machine Company's new residential college at Bradenham, Bucks, they last for three weeks.

enced instructor who, among other things, can teach him the 'tactics and strategy' of programming and also the 'short-cuts' allowed by the computer in question.

At present, there is a shortage of trained programmers, and here may well be the kernel of a serious personnel problem in the sphere of automatic data processing.

Scientists and engineers

The task of training scientific and technical staff in computer design, operation and maintenance is relatively easy, inasmuch as they already have a technical background and the ability to think logically. Even so, the majority of technical people have so far had little or no opportunity to learn about computers as it is only in recent years that such machines have been installed in universities. Moreover, the demand for courses at the advanced technical level exceeds the places available.

Advanced technical training is offered by the manufacturers, the technical colleges and the universities. Here again, it covers both computing in general and certain installations in particular with courses ranging from a few days to a few months. Examples are the post-graduate course at Birkbeck College covering numerical analysis and the theory of computing machines; and the Dip.Tech. course at Birmingham College of Technology in programming, logical design and circuitry.

For the maintenance engineer, however, one of the most valuable parts of his training consists in the time he 'lives with' the computer prior to its actual installation. It is now almost standard practice for a company which has ordered a computer to appoint one of its engineers to specialize in the machine and to send him to the manufacturers for study on the spot. Sometimes he sees the machine grow from the basic chassis to the finished hardware.

Technical colleges report a great demand for their scientific lectures and courses, especially from technologists and engineers who work for computer manufacturing companies.

Cost of training

All the training activities described here vary greatly not only in time and cost but in the form in which they are presented. Some are residential; some are compact and continuous but non-residential; and some consist of series of lectures at evening classes.

Fees are just as diverse. A one-day appreciation course for directors, for example, might cost five guineas and a two- to three-week appreciation course anything from 20 to 40 guineas.

The average cost of a course for programmers is about 30. Courses for technical people—often in the form of a series of lectures—are much cheaper: anything from £1 to £2 10s. for the series, and residential, they are naturally much more expensive; for example, the cost of the two-week Summer School on Programme Design at Cambridge University was £20.

Other training activities

Training for computers differs from most other forms of industrial instruction in that it is not a once-and-for-all process. Because of the time and cost involved in introducing a computer installation, regular contact is kept up between those who give and those who receive the training—i.e., between manufacturer and client. And in this way one side is kept informed of new technical advances and the other side with current industrial problems and proposed applications.

Finally, a word about the British Computer Society whose membership, significantly, has reached 1,650 in little over a year. One of the Society's most popular activities is its 'study groups,' purely informal gatherings at which members discuss a problem actually met with by one of their number in the course of his job. They have found these groups a first-class method of pooling existing knowledge.

The computer training picture in Britain, then, may still have one or two blank patches, but the general impression is one of enthusiastic and highly effective activity. *END*

Round-up of ADP

Britain's first Electronic Computer Exhibition will be held at Olympia, London, from November 28 to December 4. Never before has there been a chance to inspect such a comprehensive display of data processing equipment for business and engineering use. This stand-by-stand preview gives the busy executive a check-list of the latest developments in the fast-moving fields of digital and analogue computing, machine tool control and data reduction.

Air Trainers Link Ltd. Stand Ia

—Small, inexpensive mechanical analogue computer, based on the company's experience with synthetic flight simulators. A.T.L. provide a carefully selected kit of parts which are interconnected by steel tapes; also a comprehensive advisory service. In addition to its uses in industrial design, the equipment has educational value, since the mathematical processes are easily followed by watching the movements of the computer units.

—Scale model of the British European Airways training centre at Heston, where A.T.L. have installed electronic simulators representing various aircraft.

Benson-Lehner (G.B.) Ltd. Stand 12

— An automatic graph plotter—the *Electroplotter Model H*—which plots data from punched cards or punched tape at rates of up to 50 points per minute.

— Complete system for transferring data from strip chart records to punched cards or tape.

Percy Boyden & Co. Ltd. Stand 1

— New range of paper tapes for computing, data processing and process control. Made and slit to exacting standards, they are available in 5, 6, 7 and 8 channel sizes and a variety of colours.

British Computer Society Ltd. Stand 41

— Information desk, where visitors can get details of the Society's aims and activities.

— Two publications: *The Computer Journal* and *The Computer Bulletin.*

British Olivetti Ltd. Stand 42

— Photo-electric punched tape reader, with a speed of 600 digits per second.

— Tape-to-card converter. Programming—through a converter panel—enables it to select information from the tape, and reproduce it on cards in a pre-determined form. Constant data can be retained in a magnetic core 'memory.'

— Alpha - numerical electric accounting machine (with interchangeable programme bar) coupled to six-channel tape perforator, enabling tapes to be prepared as by-products of the accounting operations.

— Electric typewriter with six-channel tape perforator. The typewriter has automatic tabulation (horizontal and vertical) and interchangeable programme bar as above.

British Tabulating Machine Co. Ltd. Stands 5 and 7

— *Type 1201 Hec* computer, demonstrating the production control procedure which is in operation at the manufacturers' Letchworth factory.

— Working demonstrations of the *Type 555 Hollerith* electronic calculator, with plugboard programming.

— Information on new develop-

Equipment

ments, including the *Type 1400* data processing systems which the company will be producing in about two years' time.

British Thomson-Houston Ltd. Stand 8

— Working demonstration of a control desk for an automatic co-ordinate setter, with mechanical punched card input. Two sets of co-ordinates are fed into equipment simultaneously. The operator merely drops a card into the reading device and presses a button. After the reader has sensed the instructions punched into the card, the setting dials are positioned automatically. If required, the set dimensions are displayed on dials for checking.

— Various components for use in tracer and co-ordinate setting systems, plus sample workpieces.

— Working model of the Helisyn position control, now under development. This is a new type of mechanical positioning with applications in the numerical control of machine tools and also automatic gauging.

Bulmer's (Calculators) Ltd. Stand 45

— Demonstration of the use of *Addo-X* equipment for ADP in connection with automatic weighing procedures. Fixed supplier information is merged with variable data from the scales to produce a punched tape which can be converted into punched cards.

— Display of Friden *Flexowriter* automatic writing machines, including the *Programmatic Model FPC*. Also machines with punched card readers.

— Wide range of punched tape equipment including: Motorized tape readers; the Friden *Selectodata*, which has the ability to search out data on punched tape; and the *Teledata* tape transmitting-receiver unit.

— *Computyper Model C* for automatic billing.

Burroughs Adding Machine Ltd. Stand 28

— Desk-sized *Burroughs E101* digital computer for scientific and business statistical work, with keyboards, punched tape and punched card inputs and various outputs.

— Scale models of the large *205* and *220* data processing systems.

— *Sensimatic* accounting machines producing punched tape or punched cards as by-product of conventional accounting operations (see details for Ferranti Ltd.).

— Enclosed cinema showing films, filmstrips and slides on various aspects of ADP.

Calibrated Papers Ltd. Stand 1

— Continuous stationery for a wide range of data processing applications. The manufacturers also offer a free advisory service on form design and construction.

Creed & Co. Ltd. Stand 30

— The new *Model 3000* tape punch, specifically designed for the direct recording of computer output data and ten times as fast as the output punches available hitherto. It handles 5- 6- 7- or 8-channel tape at the speed of 300 characters per second or 3,000 words per minute.

— An experimental model of a tape-controlled putput printer which operates at 100 characters per second. —also ten times faster than current speeds. This is intended for the on-

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or off-line printing of computer data.

— The new *Creedomat*: a special IBM electric typewriter connected to Creed tape punch and reader units, enabling typed copy and punched tape to be produced simultaneously at speeds of up to 100 words per minute, with automatic play-back facilities.

— High-speed tape comparator: checks for discrepancies in two supposedly identical 5 channel tapes at about five times the speed of previously available comparators.

— A new range of edge-punched card equipment: basically, a card punch and a card-to-tape converter.

— Display of established teleprinters, reproducer sets, tape verifiers, tape readers, reperforators and other items.

Data Recording Instrument Co. Ltd. Stand 25

— Range of magnetic recording equipment suitable for data analysis.

— Drum announcer unit, as developed for the Post Office automatic fault finding equipment.

— Range of single- and multi-track recording and reproducing heads.

Egry Ltd. Stand 3

— *Automation Speed-Feed* for handling continuous business forms on tape-perforating typewriters.

— Continuous business forms incorporating means of storing punched tape and punched cards within source documents.

— Continuous form decollator, deleaver and burster, for separating continuous forms from a tabulator or computer output unit.

— On the same stand Mercedes Sterling Book Keeping and Calculating Machines Ltd. will exhibit a new range of paper tape punching machines based on their electric accounting machines and electric typewriters.

Elliott Bros. (London) Ltd. Stand 35/43

— Latest *402F* (floating point) scientific digital computer, at work on typical problems.

— New desk-sized general-purpose digital computer—the *Type 802*—using transistors, printed circuits and magnetic cores.

— Small analogue computer, based on the *G-PAC* general-purpose unit, for solving problems connected with aircraft flight control systems.

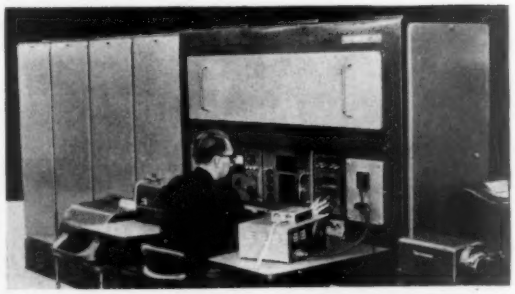
EMI Electronics Ltd. Stand 26

— An *EMIDEC 1100* general-

Do-it-yourself enters the analogue computing field. With this kit of mechanical parts and steel connecting tapes (by Air Trainers Link) the mathematician or engineer can solve a variety of problems.

Creed's new Model 3000 tape punch is probably the fastest in the world. It works at 300 characters per second—3,000 words per minute—and has been designed for direct recording computer output data.

In a demonstration of the 305 Ramac, British businessmen have their first chance to inspect IBM's unique random-access 'memory' system. It consists of magnetic discs arranged in 'juke box' fashion.



Transistors and printed circuits are widely used in the Metrovik 950 digital computer, designed for scientific and engineering work. The machine is said to be very easy to programme.

About the Exhibition

- It is organized jointly by the Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association.
- It concentrates on British achievements in the design, manufacture and use of ADP equipment.
- It is being held in the National Hall, Olympia, London, from November 28 to December 4; is open from 10 a.m. to 8 p.m. daily.
- Concurrently there is a Business Symposium (December 1 to 3) based largely on case-histories. The proceedings are being published in book form by Sir Isaac Pitman and Sons Ltd., price 5 gns.

purpose digital computer, making its first public appearance.

— The 'input multiplexing unit' of *EMIDEC 2400*, a larger data processing system now being developed under National Research Development Corporation sponsorship.

— Working demonstrations of *ENIAC II*, a general-purpose analogue computer designed in modular form.

— Various pieces of ancillary equipment, on show for the first time, including: An 8,000-word digital magnetic storage drum; 200 in. per second start-stop digital tape deck; a versatile instrumentation tape deck; and a neutron spectrometer display—one of the latest examples of digital data processing.

EMI Sales and Service Ltd. Stand 33

— Full range of magnetic recording tapes for computers and instrumentation and metering equipment; also spools.

— Test channel for measuring 'drop out.'

English Electric Co. Ltd. Stand 36

— Demonstrations of the *Deuce* *Mark II* digital computer, with magnetic tape storage units.

— Information on the well-established *Deuce Mark I*, primarily for scientific and mathematical work.

— New punched - card - operated typewriter.

— Two analogue computers: *LACE Mark II* and *K.A.E.I.*

Fairey Aviation Co. Ltd. Stand 43a

— Multi-purpose electronic analogue computer, designed to handle complex calculations associated with modern system and plant control. This machine also has wide applications in the general engineering field for the design of servo-mechanisms and for the solution of sets of non-linear differential equations (such as those concerned with heat flow problems).

Fanfold Ltd. Stand 17

— High-speed form feeding equipment and continuous forms designed to achieve maximum production from output equipment.

Ferranti Ltd. Stand 10/14

— A working *Pegasus* computer with five magnetic tape storage units, demonstrating some of the ways in which magnetic tape can be used in commercial data processing.

— Large models of two other computing systems: (1) *Perseus*, illustrating the process of up-dating commercial files; and (2) *Mercury*, illustrating the use of a scientific computer on a transportation problem.

— Ferranti are co-operating with Burroughs Adding Machine Co. and Creed in a demonstration of the way in which a central computing system can process information telegraphed from out-stations. On the Burroughs stand, a *Sensimatic* operator will post sales ledger cards. Punched paper tape obtained automatically as a by-product of this machine-accounting operation will be transmitted by land-line to the Ferranti stand, where analyses will be made on *Pegasus*. The results will then be transmitted back to Burroughs.

Jenkins Fidgeon Ltd. Stand 32

—Range of filing and storage equipment for magnetic tapes and other computer materials. New items include dust-tight cupboards and filing cabinets for housing magnetic tapes in plastic or metal containers, with provision for either individual or batch selection.

—Multi-drawer filing cabinet, seven

Many office equipment manufacturers are linking punched paper tape recorders to conventional keyboard machines. The hook-up shown here features the National Class 158 adding/book-keeping machine.

Magnetic core 'memories' are featured on The Plessey Co.'s stand. Here is one being tested.

Specially built for magnetic tape storage: PCA's Safe-Tape counter-top cabinet.

drawers high, for punched paper tapes.

—Redesigned transport trolley for magnetic tapes.

IBM United Kingdom Ltd. Stand 34

— First demonstration in Britain *305 Ramac* data processing system. To demonstrate the possibilities of random-access storage, this will produce typical business documents—invoices, stock receipts, and cheque and remittance statements—reflecting changes which have only just taken place.

— An IBM *650* computer with magnetic tape external storage.

— IBM data transceiver equipment, used for the direct transmission of punched information by telegraph, telephone line, or radio link.

— The *604/421* electronic accounting group—an established hook-up between an electronic calculator and a conventional accounting machine—demonstrating a stock availability programme.

Lamson Paragon Ltd. Stand 31

— Demonstrations of the *Formaliner* controlled carbon form feed, designed to operate with the output units of various computing systems. Latest developments: the gearing of the *Formaliner* to the Creed tape-operated teleprinter output unit.

— *Paragon* decollators and detachers, which provide fast separation of printed forms from the continuous length.

Leo Computers Ltd. Stand 27

— *LEO* control desk and test rack, with illustrations of the wide range of input/output and storage equipment which can be coupled to the computer.

— Visits arranged to the nearby *LEO I* and *LEO II* installations at Cadby Hall and Elms House.

Logabax Ltd. Stand 46

— The *Telebax*: a special ADP version of the standard *Logabax* 198-register book-keeping and accounting machine. It has no keyboard; is operated by punched paper tape.

London Office Machines Ltd. Stand 44

— Cash registers and receipting machines with perforators for producing punched paper tapes for ADP and computer input.

— Cash register which punches *Kimball* price tickets with additional information. (These tickets can then be converted to standard punched cards for automatic processing.)

Metropolitan-Vickers Electrical Co. Ltd. Stand 22

— Scale model of the new *Metrovick 1010* computer: a fast transistorized machine for data processing and real-time process control.

— *Metrovick 950* computer: inexpensive, transistorized digital computer designed primarily for mathematical, scientific or engineering work.

— *Metrovick 960* paper tape reader.

— Centralized monitoring control system for large industrial plant.

Mullard Equipment Ltd. Stand 11

— The *Autoplot* electronically-controlled co-ordinate positioning system for drilling, marking-out, plotting or draughting operations on sheet metals.

— New high-precision measuring system suitable for machine tool control.

— New system of sequence control using transistor logic circuits, a high-speed analogue-digital converter unit and variable wire delay lines.

Mullard Ltd. Stand 2

— Wide range of semi-conductor devices, valves and tubes for use in computers and allied equipment.

— Demonstration of a 100kc/s ferrite store driven by new high-frequency power transistors.

— Demonstration of the use of 'packaged' elements for the construction of a serial adder-subtractor unit.

— Magnetic 'memory' matrices using *Ferrocube* rectangular-loop cores.

National Cash Register Co. Ltd. Stand 35/43

— Typical *National-Elliott 405* installation, supported by a range of ancillary equipment, to illustrate the company's conception of integrated data processing.

— *National Class 31 EN* adding/book-keeping machine with punched paper tape recorder.

— *National Class 158* book-keeping and accounting machine with punched paper tape recorder.

— *National Class 21 ST* cash register with punched paper tape recorder and also device for reading the tags used in the *Kimball* merchandising control system.

— *National Class 31* accounting machine with *National-Hollerith 029* card punch.

— A range of standard teleprinter equipment for the preparation and verification of punched tapes.

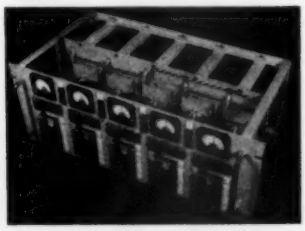
— *National Post-tronic* installation.

Neosid Ltd. Stand 37

— Wound ferrite cores for logical application.

— Miniature printed-circuit ferrite

Revolutionary output printer by Rank Precision Industries has no moving parts



Saunders-Roe are now using this standard five-amplifier computing unit with built-in patch panel. To turn it into a complete analogue computer, only power supplies have to be added

The Short general-purpose analogue computer, about 50 of which are already installed

See us there

- Readers are invited to visit Business Publications Ltd. on Stand 38.
- Additional copies of this magazine will be on sale there; also copies of BUSINESS Journal of Management and other periodicals.

pot core assemblies, as used in a number of computer applications.

Panellit Ltd. Stand 49

— Complete *Type 609* process information system consisting of: (1) automatic scanner for up to 200 process measurement points; (2) data storage and data reduction units which give off-normal indications and alarms when values deviate beyond pre-set limits; (3) computing unit (similar to the *Elliott 802*) for continuous calculations of overall process efficiency or other information; and (4) automatic electric typewriter for tabulating results.

— Latest version of the small *Elliott Miniac* analogue computer.

The Plessey Co. Ltd. Stand 6

— Wide selection of square-loop ferrite cores for use in high-speed random-access computer 'memories,' and also in various logical and switching circuits.

— Two specialized testing machines. One individually inspects each core to prove its electrical characteristics; the other automatically tests complete 'memory' planes.

— Display of transfluxor-type cores, and magnetic and superconductivity devices; also an analogous ferro-electric store.

— Transistors made by an associated company, Semiconductors Ltd.

Powers-Samas Accounting Machines (Sales) Ltd. Stand 10/14

— *Pluto*, the new electronic data processing system developed in collaboration with Ferranti, on show for the first time. It consists of a computing unit, *Pegasus*, which can be used with various input/output media: punched cards, punched paper tape and magnetic tape.

— The now familiar *Programmed Controlled Computer* (P.C.C.), an all-punched card machine which can be integrated with electro-mechanical equipment.

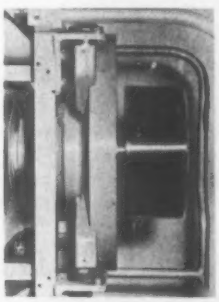
— Two *Samastronics*: one operating as an off-line output printer for magnetic tapes produced by *Pluto*, the other accepting punched cards from the P.C.C.

Punched Card Accessories Ltd. Stand 29

— Complete range of storage equipment for electronic computing materials—magnetic tape, magnetic film and punched paper tape. *Safe-Tape* cabinets, made in full-height and counter-top models with dust-resisting lockable doors, accommodate various 'insert units' to suit the type of reel and the method of handling. An insert unit for punched card trays is also available.

— A more elaborate *SafeTape* unit (capacity up to 198 reels of magnetic tape) with built-in air-conditioning plant.

Example of the wide range of Sindak data reduction equipment to be shown by Southern Instruments Computer Division. Various read-out methods are available



New magnetic drum by Sperry Gyroscope offers high-density storage

Rank Precision Industries Ltd. Stand 48

— The experimental model of an entirely new output printer. Without moving parts, it can reproduce computer output data (either on- or off-line) at 1,500 lines per minute. (In the final model this speed will probably be doubled.)

It works from either magnetic tape or the computer's buffer store. Basic principle is that a beam of electrons writes the letters or numbers on to a cathode ray tube, from which they are instantly copied by the all-dry, electrostatic process of xerography.

The xerographic part of the set-up is the Rank-XeroX *Copyflo* continuous printer, which copies original matter on to plain paper at the rate of 20ft. per minute.

Saunders-Roe Ltd. Stand 19

— Complete analogue computer assembled from the company's range of standard computing units and mounted in a three-bay forced-ventilated rack. Set up to solve a specific problem, probably connected with nuclear reactor simulation.

— The *Saro Miniputer*. Handles simple dynamic engineering problems; also intended for use in technical schools as an introduction to analogue computing techniques.

— Display of standard computing units not built into the main exhibit, including: A diode function unit; a quarter square multiplier; a limiter; and a multiplier/divider unit.

Short Bros. & Harland Ltd. Stand 4

— *Short* general-purpose analogue computer designed to solve differential equations and also to simulate actual physical systems. More than 50 of these compact, reasonably-priced instruments are already in use.

— Working demonstration of a new instrument developed for the analysis of automatic control systems.

— Low-frequency oscillator, first shown at last year's Instruments, Electronics and Automation Exhibition, now in quantity production.

— A variety of other instruments, including: a time delay unit; a new version of the company's high-speed

multiplier; a continuous function unit; a variable time switch unit; an improved servo multiplier; and a linear function unit.

Siemens Edison Swan Ltd. Stand 16

— Write-out device for recording the output of a simple analogue computer.

— Various components including: transistor - operated magneto - strictive delay lines; high-speed circuits with ferrite cores; the *XS 101* symmetrical transistor; junction transistors; high-speed uniselector equipment; and precision-moulded plastic items.

The Solartron Electronic Group Ltd. Stands 9 and 18

—*ERA* (electronic reading automatum) on show for the first time as a production model. This machine is the one which will be delivered soon to Boots Pure Drug Co. Ltd.

—*Minispace* small analogue computer, described as an 'electronic slide rule.'

—*SAKI* automatic keyboard instructor, first of a family of machines for training punched card and other operators (and also for evaluating the suitability of trainees).

—*SPACE 48*: precision analogue computer equipment and simulator consisting of 48 computer units or 'bricks.'

Southern Instruments Ltd. Stand 24

— Comprehensive display of *Sindak* data reduction equipment, featuring: (1) digital output in actual physical units shown on visual display for quick reference; (2) permanent records by electric typewriter, tape punch or card punch; and (3) rapid repetitive read-out—scaled in practical units—from any analogue voltage source.

Sperry Gyroscope Co. Ltd Stand 39

— New magnetic storage drum developed by Sperry in collaboration with the Automatic Telephone and Electric Co. Ltd. Originally designed for use in automatic telephone switching systems, but can be applied to computer systems where high density storage of information is needed.

Standard Telephones & Cables Ltd. Stand 23

— *Stantec-Zebra* digital computer: a small, medium-priced machine for scientific and commercial work.

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MERCEDES ELECTRIC TAPE PUNCH TYPEWRITER WITH 5- OR 8-CHANNEL PAPER TAPE.

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On **STAND No. 3** at The Electronic Computer Exhibition, 1958, at Olympia, Messrs. Egry Ltd. will be showing the Mercedes Electric Tape Punch Typewriter with their Automation Speed Feed.

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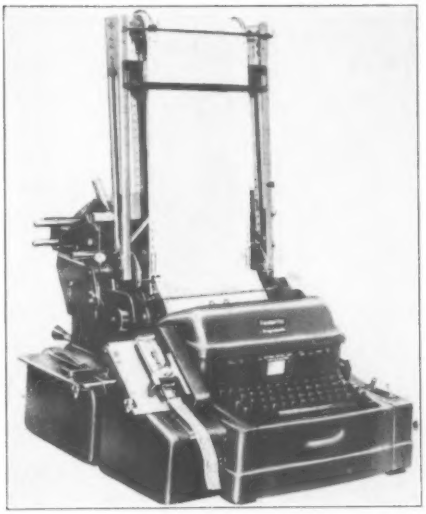
AUTOMATIC DATA PROCESSING

INTEGRATED DATA PROCESSING

ELECTRONIC DATA PROCESSING



AUTOMATION SPEED-FEED

Expressly designed to operate with tape-punch typewriters for the preparation of source documents, the Automation Speed-Feed embodies all the advantages of the standard model and incorporates additional features to meet precision alignment required in the punching of the by-product tape or card.

Carbon sheets are automatically fed into and withdrawn from each set of forms after every typing, thus obviating the use of relatively costly one-time carbon paper.

EGRY "TAPOCKET" Business Forms

(Continuous Stationery with built-in filing system)

"TAPOCKET" forms ensure positive identification of the by-product tape or edge punched card produced on a tape-punch typewriter, with a particular source document by providing a pocket into which tape or card is placed. Neither can be lost—they move with the forms until required for subsequent processing.

Continuous business forms employing N.C.R. (No Carbon Required) paper or one-time carbon sets, are also available to operate with high-speed printers or computer output unit.

"DIVI" Continuous Forms Burster

Continuous forms delivered from the high-speed printer or computer output unit need to be severed at perforations into single units. The "Divi" Forms Burster undertakes this work at very high speed and where appropriate automatically decollates one-time carbons from a multiple set.

The "Divi" Burster operates at speeds up to 30,000 forms per hour according to the form depth.

It will accept forms from 2" to 20" wide and from 2½" to 17" deep.

Slitting knives are provided to trim off marginal sprocket punching, which can also slit forms vertically at any point.

Forms can be severed at each or every alternate perforation.

The form depth adjustment is almost instantaneous and operation is extremely simple.

EGRY LIMITED

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SALES DEPT. and LONDON SHOWROOMS:
ST. GEORGE'S HOUSE,
15 HANOVER SQ., W.1
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complete automatic office installations

Tailor-made to meet *your* requirements. But *always* with a large rapid access store that takes the red-tape out of programming, and with the concurrent input and output channels that LEO pioneered. Unashamedly designed for the business and office user first, though versatile enough to do the mathematical chores as a spare time occupation.

paper tape *punched cards* *magnetic drums*

automatically checked magnetic tapes *fast printers*

LEO can link them all, and use them all, *together*.

complete service bureau facilities

LEO I has more experience of routine clerical work than any computer in the whole wide world and the first LEO II in Elms House is nearly fully loaded too. Another LEO II goes into service operation in the Spring, a LEO II with drums, Decca tapes, and a fast printer available for *your* service jobs. Anything from a 50,000 payroll to a half-hour peak job that's a nuisance to you. LEO will do the *whole* job for you from the initial planning to the on-time delivery of results

comprehensive consultancy and training services

But, of course, you will know about these; and you will know that there is no better way of buying 'down to earth' Automatic Office experience.

And if you would like to see a LEOmatic Office at work you can get an invitation from

Stand 27, Computer Exhibition, Olympia

or from LEO COMPUTERS Limited, Elms House, London, W 6